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MARJORY STONEMAN DOUGLAS WILDERNESS
EVERGLADES NATIONAL PARK

WILDERNESS CHARACTER BASELINE ASSESSMENT

JUNE 2022

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Marjory Stoneman Douglas Wilderness, Everglades National Park

Wilderness Character Baseline Assessment

Building Blocks for Wilderness Stewardship

Everglades National Park
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This Wilderness Character Baseline Assessment has been prepared as a collaborative effort between a park interdisciplinary team and is recommended for approval by the superintendent.

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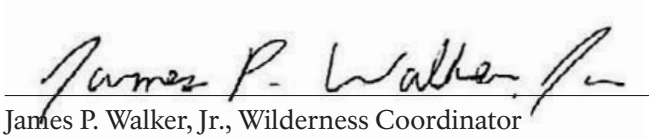

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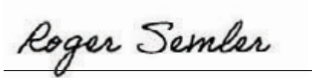

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Marjory Stoneman Douglas Wilderness, Everglades National Park Wilderness Character Baseline Assessment

EXECUTIVE SUMMARY

The central legislative mandate of the Wilderness Act of 1964 is to preserve the wilderness character of protected areas included in the National Wilderness Preservation System. This mandate has been affirmed in National Park Service policy, which also extends this level of protection to areas that have been proposed for wilderness designation until the legislative process has been completed. Administrative boundaries alone are insufficient to protect wilderness character. The only way to know whether the wilderness character of an area is preserved is to systematically monitor it.

This report is the baseline assessment of wilderness character for the Marjory Stoneman Douglas Wilderness and other lands managed as wilderness at Everglades National Park. The intent of this report and the associated wilderness character measures is to improve wilderness stewardship by informing managers' understanding of the wilderness they manage, how wilderness character is changing over time, and why changes have occurred. This assessment contains two principal aspects: (1) a qualitative *Wilderness Character Narrative*, which describes the unique and often-intangible values of the Marjory Stoneman Douglas Wilderness and other lands managed as wilderness at Everglades National Park, and (2) a quantitative *Baseline Monitoring Assessment*, which offers specific data-based measures of wilderness character and establishes a protocol that will be used to monitor change in wilderness character at Everglades National Park far into the future. Together, the Wilderness Character Narrative and Baseline Monitoring Assessment form the *Building Blocks for Wilderness Stewardship*. They provide a holistic understanding of wilderness character in the Marjory Stoneman Douglas Wilderness and demonstrate what sets this special place apart from other public lands and wilderness areas across the nation.

This report fulfills two parts of the directive in NPS Director's Order 41 which states (1) "wilderness parks should develop a wilderness character narrative which describes what is unique and special about a specific wilderness" and (2) "wilderness parks will conduct a wilderness character assessment, which includes identifying what should be measured, establishing baseline data, and conducting ongoing monitoring of trends." Additionally, this document is intended to fulfill the *Keeping It Wild in the National Park Service* (2014) recommendation that encourages every park with wilderness resources "to identify any immediate concerns in wilderness, and to inform managers and the public about the current status of wilderness character."

This report is intended to serve as a standalone document that outlines a framework and monitoring protocol for ongoing wilderness character monitoring at Everglades National Park, which should occur every five years per Director's Order 41. This report is also intended to serve as a foundation document to support the process of developing a wilderness stewardship plan at Everglades National Park. Finally, this report seeks to empower land managers with the knowledge needed to make carefully weighted wilderness stewardship decisions that respect and preserve the wilderness character of the Marjory Stoneman Douglas Wilderness for generations to come.

ACKNOWLEDGEMENTS

This report would not have been possible without the support and cooperation of the following dedicated individuals and National Park Service staff, who, despite limited time and resources, generously offered their assistance and wealth of knowledge:

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INTRODUCTION

The Wilderness Act of 1964 (PL No. 88-577, 78 Stat. 890) was passed by a nearly unanimous vote in the United States Congress to protect some federal public lands from the seemingly endless threats of "expanding settlement and growing mechanization." The primary mandate of the Wilderness Act is given in section 4(b) and states that "each agency administering any area designated as wilderness shall be responsible for *preserving the wilderness character of the area*" [emphasis added]. To establish a common understanding of this directive, wilderness character was formally defined by an interagency monitoring team representing the US Forest Service (FS) (Department of Agriculture), as well as the US Fish and Wildlife Service (USFWS), National Park Service (NPS), and Bureau of Land Management (Department of the Interior):

> *Wilderness character is a holistic concept based on the interaction of (1) biophysical environments primarily free from modern human manipulation and impact, (2) personal experiences in natural environments relatively free from the encumbrances and signs of modern society, and (3) symbolic meanings of humility, restraint, and interdependence that inspire human connection with nature. Taken together, these tangible and intangible values define wilderness character and distinguish wilderness from all other lands (Landres et al. 2015).*

Wilderness character is defined as *"The combination of biophysical, experiential, and symbolic ideals that distinguishes wilderness from other lands. The five qualities of wilderness character are Untrammeled, Undeveloped, Natural, Solitude or a Primitive and Unconfined Type of Recreation, and Other Features of Value"* (source: NPS *Reference Manual #41*, Wilderness Definitions). These qualities are derived from the statutory definition of wilderness established in section 2(c) of the Wilderness Act and are applicable nationally to all wilderness areas regardless of their size, location, administering federal agency, or other unique place-specific attributes. The definitions of each quality as established in NPS *Reference Manual # 41*, Wilderness Definitions, are below.

UNTRAMMELED

Wilderness Act Citation: Wilderness is *"…an area where the earth and its community of life are untrammeled by man"*

Definition of Untrammeled: Essentially unhindered and free from the actions of modern human control or manipulation.

NATURAL

Wilderness Act Citation: Wilderness *"…is protected and managed so as to preserve its natural conditions"*

Definition of Natural: Ecological systems are substantially free from the effects of modern civilization.

UNDEVELOPED

Wilderness Act Citation: Wilderness is *"…an area of undeveloped Federal land … without permanent improvements or human habitation"*

Definition of Undeveloped: Retaining its primeval character and influence and is essentially without permanent improvement or modern human occupation.

SOLITUDE OR PRIMITIVE AND UNCONFINED RECREATION

Wilderness Act Citation: Wilderness *"…has outstanding opportunities for solitude or a primitive and unconfined type of recreation"*

Definition of Solitude: The state of being alone or remote from habitations or the sights and sounds of other people; the experience of being in an unfrequented or secluded place.

Definition of Primitive and Unconfined Recreation: No specific definition in Reference Manual #41, but statement infers opportunities to exercise independence and self-reliance.

OTHER FEATURES OF VALUE

Wilderness Act Citation: Wilderness *"…may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value"*

Definition of the Other Features of Value: Attributes not required of or found in every wilderness that reflect the wilderness character of a specific wilderness. Based on the last clause of Section 2(c) of the Wilderness Act which states that wilderness "may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value." It captures important elements of wilderness that are not covered in the other four qualities of wilderness character, such as cultural or paleontological resources.

In addition to these five tangible qualities of wilderness character, wilderness also has important intangible aspects that are difficult or impossible to quantify or monitor. These intangible aspects are diverse and can include spiritual experiences, traditional ecological knowledge, immensity of an area, and opportunities for self-discovery, self-reliance, and challenge, and risk that come from wilderness settings. Currently, these intangible aspects of wilderness can only be addressed in narrative form.

Wilderness character may change over time and may be improved or degraded by the actions or inaction of managers. The challenge of wilderness stewardship is that decisions and management actions taken to protect one quality of wilderness character may degrade another quality. In addition, the accumulated result of seemingly small decisions and actions may cause a significant gain or loss of wilderness character over time. Because of this complexity, preserving wilderness character requires that agency staff document decisions made in wilderness and the impacts of those decisions.

In 2008, an Interagency Team published a national strategy for monitoring trends in wilderness character titled *Keeping It Wild: An Interagency Strategy for Monitoring Trends in Wilderness Character Across the National Wilderness Preservation System* (Landres et al. 2008). The monitoring strategy described in *Keeping It Wild* was implemented nationally from 2008 to 2014 and has proved to be an effective tool for wilderness managers with limited resources. Based on lessons learned during this initial implementation of wilderness character monitoring, the framework was revised and updated; the changes made are reflected in *Keeping It Wild 2: An Updated Interagency Strategy to Monitor Trends in Wilderness Character Across the National Wilderness Preservation System* (Landres et al. 2015). The wilderness character monitoring strategy for the Marjory Stoneman Douglas Wilderness contained in this document reflects the revised monitoring strategy described in *Keeping It Wild 2*.

The framework of wilderness character monitoring is based on the qualities defined above. Each quality is divided into a hierarchical set of monitoring questions, indicators, and measures to assess trends in wilderness character over time. Monitoring questions frame wilderness character monitoring to answer particular management questions; indicators are distinct and important elements within each monitoring question; and measures are a specific aspect of wilderness on which data are collected to assess trend in an indicator (Landres et al. 2008 and 2015). Expanded definitions of wilderness character monitoring qualities, monitoring questions, indicators, and measures are available in appendix A. While the qualities, monitoring questions, and indicators are nationally consistent, measures are specific and sometimes unique to individual wilderness areas (Figure 1).

This framework balances national and local needs for monitoring by defining locally relevant measures whose trends can be compiled at the park level, as well as higher levels for national or regional reporting. This interagency monitoring strategy

- provides on-the-ground information to assess trends and make defensible decisions;
- provides valuable information on wilderness on regional and national scales;
- informs key wilderness stewardship goals;
- communicates a common definition of wilderness character;
- communicates a tangible vision of wilderness within the agency and to the public;
- clarifies how stewardship decisions and actions influence wilderness preservation;
- evaluates and documents the effects of actions taken inside the wilderness and effects from threats outside the wilderness;
- synthesizes data into a single, holistic assessment of wilderness character;
- creates a legacy of staff experience and knowledge of a wilderness; and
- improves on-the-ground wilderness stewardship.

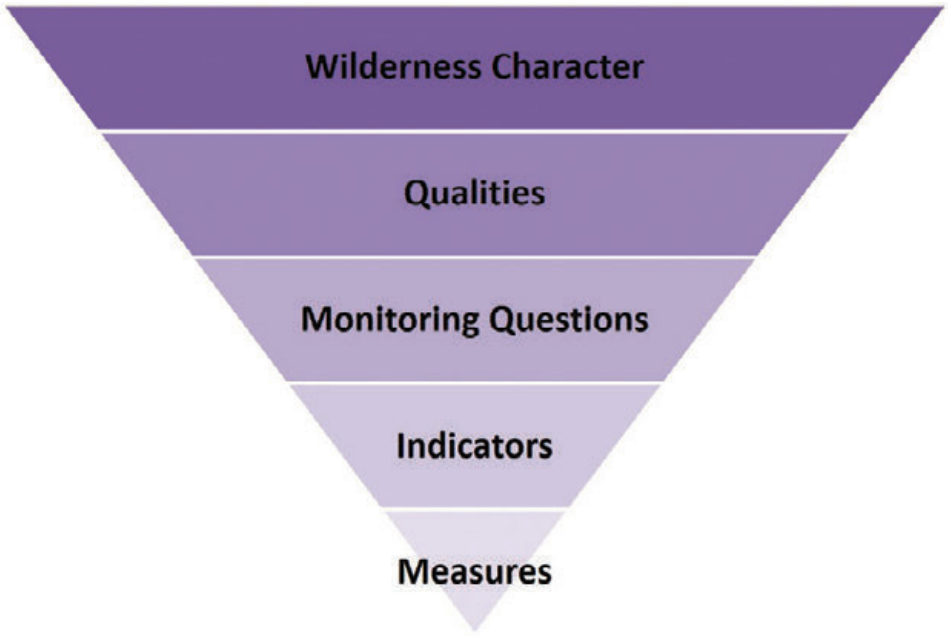

Figure 1. Keeping It Wild hierarchical framework.

This monitoring strategy offers a consistent means for documenting the status and trends in wilderness character and wilderness management within a wilderness. Under this monitoring strategy, trends in wilderness character are classified as upward (positive), downward (negative), or stable. These trends are both nationally consistent and independent of the unique aspects specific to any given wilderness; therefore, trends in wilderness character can be compared between wildernesses or across regions. These trends cannot be used to "rate" or "grade" stewardship, however, since they are meaningless when taken out of the context of wilderness character monitoring—wilderness character monitoring is a tool to holistically assess the preservation of wilderness character, not to place judgment on managers. Similarly, while *trends* can be compared between wildernesses, comparing *wilderness character itself* among different wildernesses is inappropriate. Each wilderness is unique in its legislative and administrative direction and in its social and biophysical setting; therefore, wilderness character in a particular wilderness cannot, and will not, be compared to that of another wilderness.

The purpose of this report, the measures of wilderness character, and the wilderness character narrative is to improve wilderness stewardship by informing managers' understanding of the wilderness they manage, how wilderness character is changing over time, and why changes may have occurred. The following report establishes a baseline condition and monitoring strategy for the Marjory Stoneman Douglas Wilderness based on the five qualities of wilderness character as well as the measures that are specific to the Marjory Stoneman Douglas Wilderness and indicative of local trends in wilderness character. Trends are currently monitored through the online Wilderness Character Monitoring Database (at https://wc.wilderness.net/)* which includes entries for all measures and baseline data specific to this wilderness. In order to assure that data will be collected and entered into the Interagency Wilderness Character Monitoring Database in the future, it is recommended that wilderness character monitoring be added to annual workload planning.

* In the future, the National Park Service may use a different database than the one currently administered through wilderness.net. The current database is account limited and not publicly accessible.

WILDERNESS CHARACTER IN THE NATIONAL PARK SERVICE

Preserving wilderness character in the National Park Service is vital to national wilderness preservation. The NPS administers more than 44 million acres† of designated wilderness within the National Wilderness Preservation System. Of all lands managed by NPS, over 80% have been designated as wilderness or are formally eligible, proposed, potential, or recommended wilderness—more total land and a greater proportion of land than any other wilderness management agency.

NPS policy affirms the mandate of the Wilderness Act to preserve wilderness character. The NPS *Management Policies (2006a)* on Wilderness Preservation and Management (chapter 6) single out preservation of wilderness character and mandate consideration of wilderness character in actions spanning resource management, environmental compliance, analysis of minimum requirements, cultural resource protection, management of facilities and signs, and interpretation and education.

Spurred by NPS policy and building on the framework of *Keeping It Wild*, the National Park Service Wilderness Character Integration Team published *Keeping It Wild in the National Park Service: A User Guide to Integrating Wilderness Character into Park Planning, Management, and Monitoring* (hereafter referred to as the *NPS User Guide*) in 2014. The purpose of the *NPS User Guide* is to provide an NPS-specific reference tool to help managers "integrate wilderness character into park planning, management, and monitoring" while serving as a companion document to the 2014 *Wilderness Stewardship Plan Handbook: Planning to Preserve Wilderness Character*. Both documents are included as part of *Reference Manual 41: Wilderness Stewardship*, which acts as the primary level 3 guidance for wilderness stewardship in the National Park Service.

Director's Order 41: *Wilderness Stewardship*, signed in 2013, provides the following direction regarding our responsibilities for the preservation of wilderness character in section 6.2, "Wilderness Character":

- "Whenever a park planning process that has the potential to affect wilderness character occurs, the park should determine how wilderness character can be both integrated into the planning effort and presented in the planning document.
- "As a foundation, wilderness parks should develop a wilderness character narrative which describes what is unique and special about a specific wilderness, organized by each quality of wilderness character."
- "Wilderness character should be considered in the management and operations conducted by all divisions/work units (e.g., natural and cultural resources management, facilities management, interpretation and education, resource and visitor protection, environmental compliance, and commercial services)."
- "Wilderness parks will conduct a wilderness character assessment, which includes identifying what should be measured, establishing baseline data, and conducting ongoing monitoring of trends"

Director's Order 41 also references the five qualities of wilderness character in *Keeping It Wild*, which form the basis of this document, and directs managers to the *NPS User Guide* to inform the implementation of these wilderness character directives.

This report fulfills two parts of the directive in Director's Order 41 through the development of a wilderness character narrative and the completion of a wilderness character monitoring baseline assessment. Additionally, this document fulfills the *NPS User Guide* recommendation that encourages every park with wilderness resources "to identify any immediate concerns in wilderness, and to inform managers and the public about the current status of wilderness character."

† Metric is based on the NPS 2021 wilderness inventory.

HISTORICAL AND ADMINISTRATIVE SETTING OF WILDERNESS AT EVERGLADES NATIONAL PARK

NPS Photo, C. Rivas

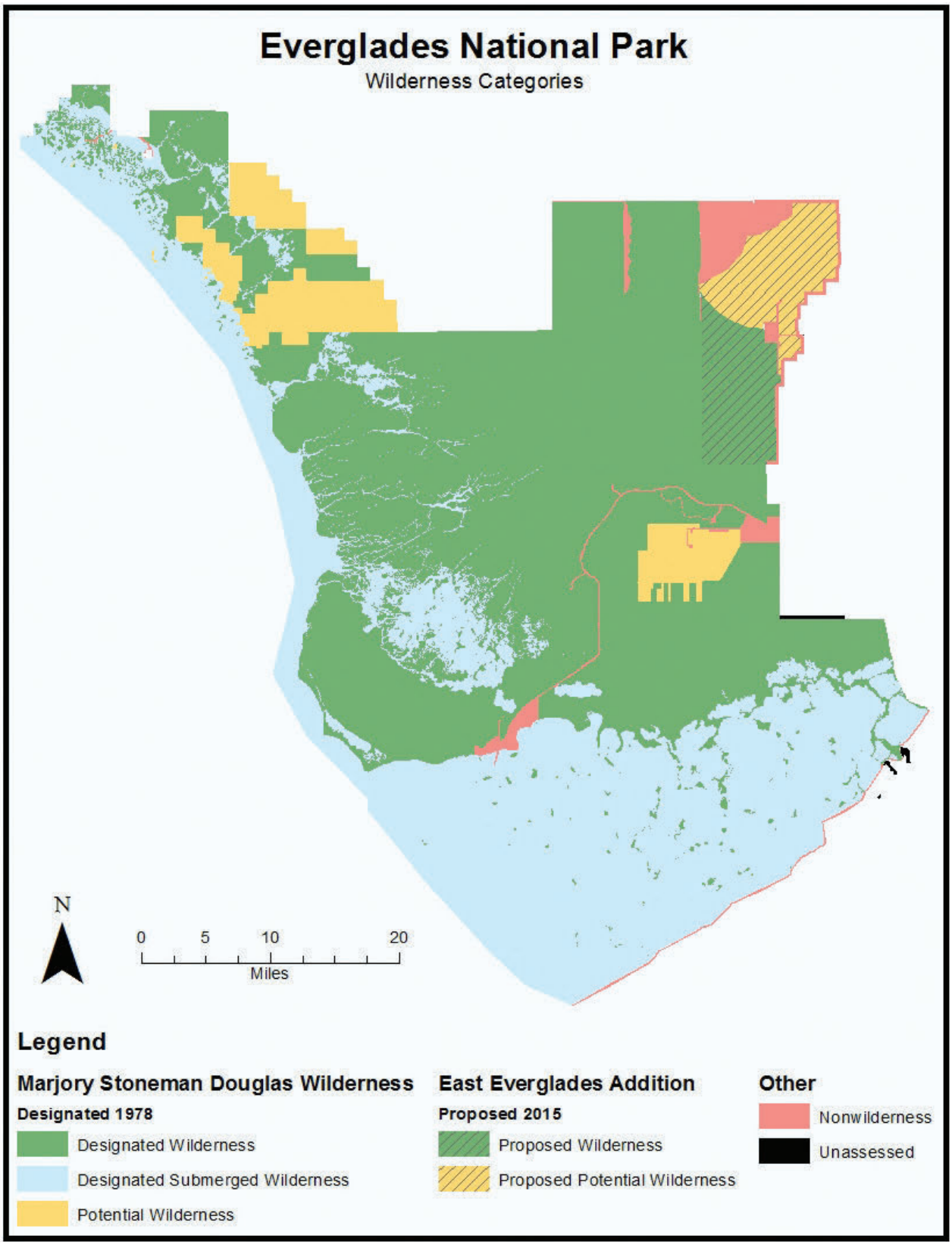

Figure 2. Marjory Stoneman Douglas Wilderness and other wilderness areas at Everglades National Park as of August 20, 2021.

HISTORICAL AND ADMINISTRATIVE SETTING OF WILDERNESS AT EVERGLADES NATIONAL PARK

This section provides an overview of the Marjory Stoneman Douglas Wilderness and other lands managed as wilderness at Everglades National Park, including legislative history, status, and boundaries.

WILDERNESS LEGISLATION AND LEGISLATIVE HISTORY

The Wilderness Act, signed into law in 1964, created the National Wilderness Preservation System to ensure an enduring resource of wilderness for future generations. The act provides that wilderness areas are to possess the following characteristics:

- The earth and its community of life are untrammeled by humans, where humans are visitors and do not remain.
- The area is undeveloped and retains its primeval character and influence without permanent improvements or human habitation.
- The area generally appears to have been affected primarily by the forces of nature, with the imprint of humans' work substantially unnoticeable.
- The area is protected and managed so as to preserve its natural conditions.
- The area offers outstanding opportunities for solitude or a primitive and unconfined type of recreation.

Consistent with requirements of the Wilderness Act, the National Park Service undertook a wilderness study of Everglades National Park in the early 1970s. A draft wilderness proposal covering 849,400 acres was released for public comment in April 1974. The proposal called for 764,700 acres of designated wilderness, consisting of undeveloped areas to the east, west, and north of the road to Flamingo, together with 84,700 acres of potential wilderness. "Potential wilderness" refers to areas in private ownership, as well as areas characterized by nonconforming uses, such as the presence of structures or the use of motorized equipment. These areas can be converted to wilderness upon the acquisition of the private interest and/or the termination of nonconforming uses. In the interim, these lands are managed as wilderness to the extent practicable. The potential wilderness was made up primarily of agricultural land in the center of the park known as the Hole-in-the-Donut, as well as various private tracts and private mineral estates in the northwest part of the park below Chokoloskee.

In response to public comment and further study, the National Park Service produced a Wilderness Recommendation in August 1974. The Wilderness Recommendation reduced the area of potential wilderness to 81,900 acres and increased the total designated wilderness to 1,296,500 acres. The acreage added to designated wilderness comprised a 2,400-acre pineland unit north of the Hole-in-the-Donut, as well as 529,300 acres of submerged marine lands. An environmental impact statement covering the Wilderness Recommendation was approved on June 23, 1978. By that point, legislation had already been introduced in Congress to designate wilderness at Everglades National Park.

Legislation establishing the Everglades Wilderness was passed by Congress in October 1978 and signed into law by President Jimmy Carter on November 10, 1978. As established, the wilderness covers approximately 1,378,400 acres, consisting of 1,296,500 acres of designated wilderness and 81,900 acres of potential wilderness. The Everglades Wilderness was renamed the Marjory Stoneman Douglas Wilderness by Congress in 1997 to commemorate the vision, leadership, and enduring contributions of Marjory Stoneman Douglas in protecting the Everglades and establishing Everglades National Park. As of 2021, it is the only NPS wilderness area named after a woman. See Public Laws 95-625 (1978) and 105-82 (1997).

Per section 6.2 of NPS *Management Policies 2006*, the National Park Service completed a wilderness study of the East Everglades Addition of the park in 2015 (see Figure 2). The preferred alternative of the study proposed the designation of approximately 42,200 acres in the East Everglades Addition as wilderness and an additional 43,100 acres as potential wilderness.

The preferred alternative was adopted in a Record of Decision signed on October 23, 2015.

Three miscellaneous tracts of land within Everglades National Park have yet to be evaluated for wilderness eligibility. Pursuant to section 6.2 of NPS *Management Policies 2006*, the National Park Service intends to initiate a wilderness eligibility assessment for these areas in late 2021. A notice to the federal register would be published at that time.

CURRENT LAND STATUS, BOUNDARY DESCRIPTIONS, AND MAP

Currently, the National Park Service manages a total of 1,463,700 acres in the park in such a way as to preserve or enhance their wilderness character (Figure 2). The categories of wilderness in the park are broken down as follows: 1,296,500 acres designated wilderness (nearly 86% of the park), 81,900 acres potential wilderness, 42,200 acres proposed wilderness (in the southern portion of the East Everglades Addition), and 43,100 acres proposed potential wilderness (in the northern part of the East Everglades Addition. Additionally, in late 2021, the National Park Service intends to evaluate wilderness eligibility for three miscellaneous tracts within park boundaries that are yet unassessed. By policy, the National Park Service manages all categories of wilderness, including eligible lands, in such a way as to preserve their wilderness character until Congress decides whether or not to designate them as wilderness. See NPS *Management Policies 2006*, section 6.3.1, "General Policy." The Marjory Stoneman Douglas Wilderness includes most of the park's undeveloped lands and inland waters. Furthermore, the majority of marine waters within the wilderness boundary are considered "submerged marine land wilderness" (i.e., the sea floor is under traditional wilderness protection, but the water column is non-wilderness). Submerged marine land wilderness in the park comprises all areas underwater during high tide in Florida Bay and Ten Thousand Islands, as well as the following inland waterbodies: Coot Bay, Davis Creek, East Cape Canal between Lake Ingraham and Florida Bay, East Creek, House Ditch downstream of its plug, Joe Bay, Lake Ingraham, Little Sable Creek, McCormick Creek, Middle Cape Canal, Mud Creek, Slagle Ditch downstream of its plug, Taylor Creek, Taylor River, Trout Creek, and West Lake.

Notable areas of potential wilderness in the park include the Hole-in-the-Donut area, where the park is restoring approximately 6,000 acres of former agricultural land infested by Brazilian pepper, and certain areas in the northwestern part of the park still underlain by nonfederal mineral rights. Per Public Law 95-625, any lands that represent potential wilderness additions would become designated wilderness upon publication in the Federal Register of a notice by the secretary of the interior that all uses thereon prohibited by the Wilderness Act have ceased.

Some isolated areas within the wilderness boundary are designated non-wilderness. These are typically areas of continuous, nonconforming uses such as levees and radio repeater antennae sites. Non-wilderness within the exterior boundary of the Marjory Stoneman Douglas Wilderness include a 1-acre circular parcel surrounding the site of the old Lostmans River Ranger Station, a 1-acre semicircular parcel at the Levee 31W canal pumping station, the Buttonwood Canal, and the Levee 67 extension canal.

RELATIONSHIP OF WILDERNESS TO OTHER PLANS

Management of the park wilderness was addressed in the 1981 *Backcountry Management Plan* with additional guidance in the 1979 Master Plan and 2015 General Management Plan. The general management plan established various management zones in the park, including four that overlap designated and proposed wilderness: "Backcountry (nonmotorized)," "Boat Access," "Pole/Troll," and "Pole/Troll/Idle." These zones are coextensive with the Marjory Stoneman Douglas Wilderness (including submerged marine land wilderness) and areas of proposed wilderness in the East Everglades Addition. However, the zones provide only general guidance for wilderness management.

Although the backcountry management plan set forth specifics of how the wilderness was to be managed, updated guidance is needed consistent with Director's Order 41 ("Wilderness Stewardship") and the 2014 NPS *Wilderness Stewardship Plan Handbook*. Building on the 2015 *General Management Plan/East Everglades Wilderness Study*, the park's wilderness stewardship plan will incorporate new information and understanding about changes in visitor use patterns,

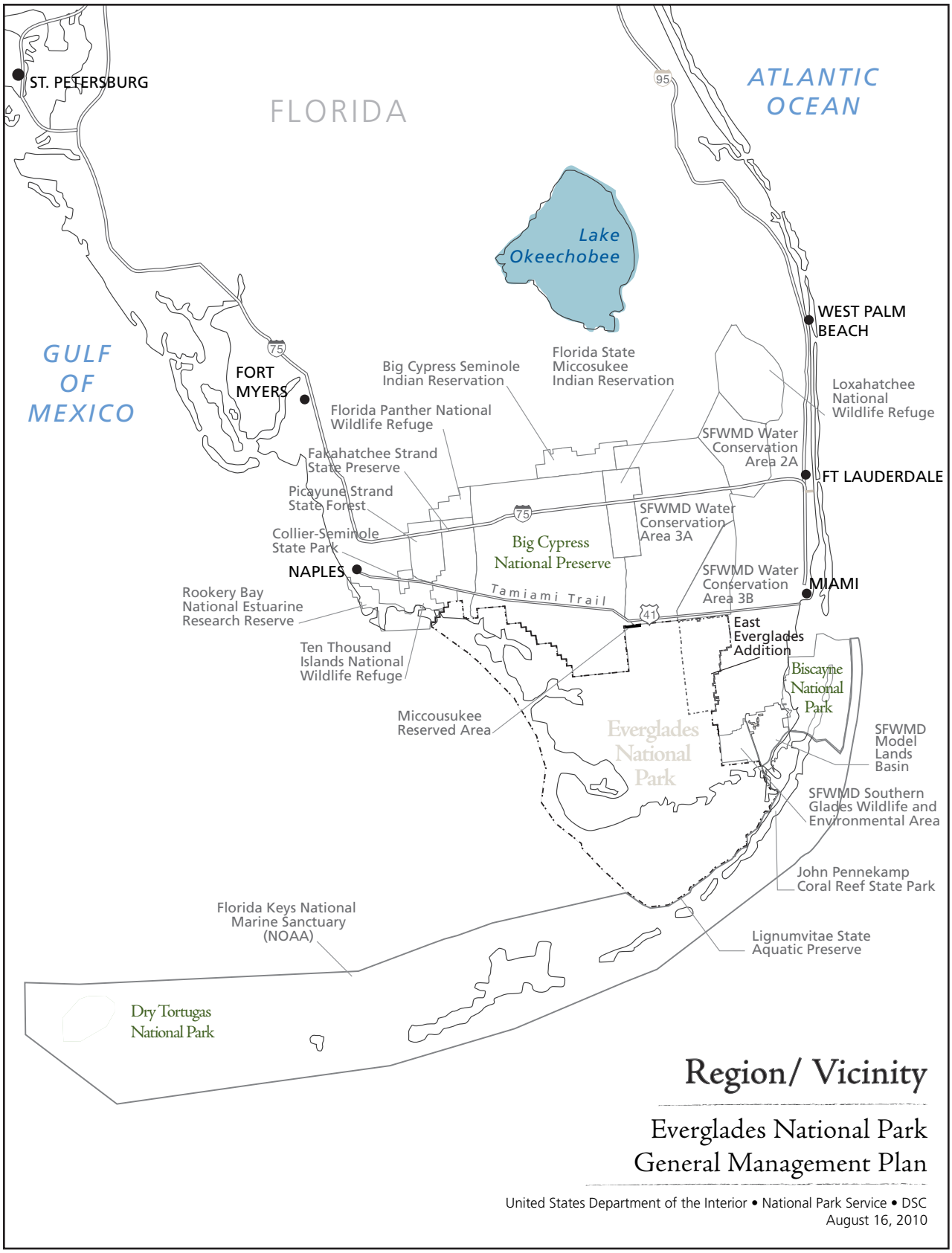

Figure 3. Region/vicinity map.

methods of managing visitor use, ecosystem restoration, and natural resource management in wilderness. The wilderness stewardship plan will reiterate the values of the backcountry management plan and supplement other planning efforts, such as the climate action plan and fire management plan, while providing comprehensive guidance for the administration of wilderness at Everglades National Park.

The Comprehensive Everglades Restoration Plan (CERP), authorized by Congress in 2000, addresses the greater Everglades ecosystem including Everglades National Park and the historic drainage area north toward Lake Okeechobee (Figure 3). This plan aims at restoring, protecting, and preserving the water resources of central and southern Florida through redirecting freshwater flows to benefit both people and the environment. Although intended to mimic natural conditions, restoration activities involve a significant amount of trammeling in the Marjory Stoneman Douglas Wilderness and other lands managed as wilderness at Everglades National Park, while also requiring constant monitoring to assess its success. The wilderness stewardship plan will work with the Comprehensive Everglades Restoration Plan to minimize extraneous impacts to wilderness character while allowing for an assessment of CERP success.

NPS Photo, M. Collier.

MARJORY STONEMAN DOUGLAS WILDERNESS CHARACTER NARRATIVE

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MARJORY STONEMAN DOUGLAS WILDERNESS CHARACTER NARRATIVE

This wilderness character narrative qualitatively describes what is unique and special about the Marjory Stoneman Douglas Wilderness and other lands managed as wilderness at Everglades National Park in terms of the five tangible qualities, as well as intangible qualities, of wilderness character. It is a foundational document intended to convey the current and foreseeable future condition of the wilderness, identify fundamental wilderness resources, and acknowledge important intangible values associated with the wilderness.

INTRODUCTION

A wilderness character narrative is intended to be a qualitative description and positive affirmation of the unique attributes of a wilderness area. Representatives from each of the four wilderness managing agencies developed a national framework to monitor wilderness character using five qualities: untrammeled, natural, undeveloped, opportunities for solitude or primitive and unconfined recreation, and other features of value. These qualities are defined in NPS *Reference Manual #41,* Wilderness Definitions (unless otherwise noted) as follows:

> ***Untrammeled:*** *Essentially unhindered and free from modern human control or manipulation.*
>
> ***Natural****: Ecological systems which are substantially free from the effects of modern civilization.*
>
> ***Undeveloped****: Retaining its primeval character and influence and is essentially without permanent improvements or modern human occupation.*
>
> ***Solitude or Primitive and Unconfined Recreation:*** *Wilderness provides outstanding opportunities for recreation in an environment that is relatively free from the encumbrances of modern society, and for the experience of the benefits and inspiration derived from self-reliance, self-discovery, physical and mental challenge, and freedom from societal obligations.* (Landres et al. 2015)
>
> ***Other Features of Value:*** *Attributes not required of or found in every wilderness that reflect the wilderness character of a specific wilderness. Based on the last clause of section 2(c) of the Wilderness Act which states that a wilderness "may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value." It captures important elements of the wilderness that are not covered in the other four qualities of wilderness character, such as cultural or paleontological resources.*

The following wilderness character narrative is intended to familiarize readers with the tangible and intangible resources and values that combine to create the Marjory Stoneman Douglas Wilderness at Everglades National Park. The document was created through collaboration among NPS staff and is a record of the shared understanding of wilderness character exemplified by the Marjory Stoneman Douglas Wilderness.

This narrative serves as a framework for a wilderness stewardship plan, fosters integration among different staff and program areas that need to function together to effectively preserve wilderness character and serves as a starting point for discussion with the public about the current and future state of the wilderness. Other more analytical documents, such as the wilderness character baseline assessment report, may be derived from the qualitative description and threats to wilderness character identified by this wilderness character narrative.

OVERVIEW OF THE MARJORY STONEMAN DOUGLAS WILDERNESS

At the southern tip of the peninsula that is the State of Florida lies the Marjory Stoneman Douglas Wilderness. Fully encompassed within Everglades National Park, this area was considered wilderness long before the Wilderness Act was signed into law. As stated in the enabling legislation for the park, this area "shall be permanently reserved as a wilderness, and no development of the project or plan for the

entertainment of visitors shall be undertaken which will interfere with the preservation intact of the unique flora and fauna and the essential primitive natural conditions now prevailing in this area" (16 U.S.C. sec. 410c). Though signed 30 years prior to the Wilderness Act, the park's enabling legislation is analogous in its fundamental aims.

The Marjory Stoneman Douglas Wilderness is the largest unit of the National Wilderness Preservation System east of the Rocky Mountains. In character, it harks back to a primordial time full of mystery and intrigue. It is a wet, hot, and humid environment teeming with mosquitoes, hazardous wildlife, and poisonous plants, and is both unforgiving and inhospitable. There is no debating these facts; however, if given the chance, visitors will find that this area is also wondrous, enchanting, and beautiful.

The wilderness is a vast complex of seasonally or permanently flooded ecosystems interspersed with isolated patches of dry ground that one may explore with few signs of modern human presence. It is a unique subtropical wetland that connects central Florida's freshwater ecosystem with the marine systems of Florida Bay and the Gulf of Mexico. The Everglades is an outstanding and subtle landscape, one that seems both bountiful in resources and spectacular in its neverending waterways, diverse wildlife, and sprawling scenic views. Visitors to the wilderness have the opportunity to enjoy a relatively undeveloped and wild landscape, where they can view numerous threatened and endangered species, slog through backcountry sloughs, and sleep under starlit skies, all within a stone's throw of a major metropolitan area.

Besides affording outstanding recreational benefits, the Marjory Stoneman Douglas Wilderness serves as an essential recharge for South Florida's water supply, a natural line of defense against the impacts of tropical storms and a vital nursing ground for numerous aquatic and avian species. It also harbors an extensive array of cultural resources. Many have been documented and determined eligible for listing on the National Register of Historic Places, while others are still to be identified and evaluated for significance. These resources include archaeological, ethnographical, historic and prehistoric structures, and cultural landscapes.

The importance of the Marjory Stoneman Douglas Wilderness is reflected in its designations as an International Biosphere Reserve, a World Heritage Site, and a Ramsar Wetland of International Importance. This combination of distinctions is unmatched anywhere else in the United States.

The following narrative describes in more detail what is unique and special about the Marjory Stoneman Douglas Wilderness, while noting some of the major threats to the area's wilderness character. It is organized by the five tangible and measurable qualities of wilderness character, namely, the untrammeled, natural, and undeveloped qualities, as well as opportunities for solitude or primitive and unconfined recreation, and other features of value.

NPS Photo, M. Nectoux

UNTRAMMELED

Definition: Wilderness is essentially unhindered and free from modern human control or manipulation. This quality represents the "wild," in "wilderness." Any intentional or unintentional, authorized or unauthorized treatment or action that manipulates the wilderness degrades this quality. Perpetuating the Untrammeled Quality requires managers to restrain themselves, rather than restraining the wilderness. Often, upholding the Untrammeled Quality can detract from another wilderness quality, such as "naturalness," or vice versa. For example, nonnative species may be removed in order to attain natural species composition, which would in turn be a manipulation of the current wilderness.

Figure 4. Homestead Canal.

Figure 5. Freshwater rivers meet saltwater oceans in a vast expanse of the Everglades.

As anyone venturing into the heart of the wilderness can attest, this vast wetland "appears to have been affected primarily by the forces of nature" and to the average visitor seems to be an area where the "earth and its community of life are untrammeled by man." However, the story of the Everglades cannot be told without also taking note of the attempts of humans to manipulate and cultivate its landscape. In the decades leading up to the dedication of Everglades National Park, numerous attempts were made to exploit the region's resources. Canals intended to expedite drainage were constructed both inside and out of the modern wilderness boundary (Figure 4). These changes caused widespread damage to the land and its ecological systems. Inflow patterns from the upper watershed were altered dramatically, as were hydrologic flow within the wilderness itself. These flows must now be intentionally manipulated to perpetuate the natural conditions for which Everglades National Park was established. The result is long-term degradation of the Untrammeled Quality of wilderness character, even as the Natural Quality is maintained or enhanced.

Despite efforts to tame the land, biophysical processes remain the predominant features of the landscape. The cycle of life here continues largely unfettered. The fascinating biodiversity, including fish, birds, and all other forms of wildlife, are free to roam and forage unimpeded by human-caused restrictions. Likewise, most natural creeks and rivers openly flow through estuarine areas to the sea without impedance from artificial plugs or dams (Figure 5). Wildfires, which clear and rejuvenate the landscape, are generally allowed to burn unsuppressed, contributing to the natural cycle of succession. Perennial dynamic forces—violent storms, flood and drought, fire, and coastal wave action—continue to shape the region and do so freely.

As wild as this wilderness appears, there are a variety of threats to the Untrammeled Quality. Most trammeling actions that threaten the wilderness center around three activities—environmental restoration, fire, and exotic species control—all of which are typically undertaken to preserve the Natural Quality of wilderness character. Water control structures on the periphery of the wilderness boundary are manually

operated to counteract the effects of past actions. Additionally, active manipulations to restore seagrass scars in Florida Bay impact this quality. Even though naturally ignited fires generally burn unimpeded within the wilderness, the application of prescribed fire to the landscape results in trammeling. (Note, however, that such trammeling enhances the opportunity for future wildfires to go unsuppressed.) Similarly, unauthorized ignitions that have a physical affect upon the wilderness, regardless of ignition point, degrade the Untrammeled Quality. Finally, the removal of exotic plant and animal species, whether by mechanical or chemical means, qualifies as a trammeling of the wilderness even when conducted using nonmechanized means.

NATURAL

Definition: Wilderness maintains ecological systems that are substantially free from the effects of modern civilization.

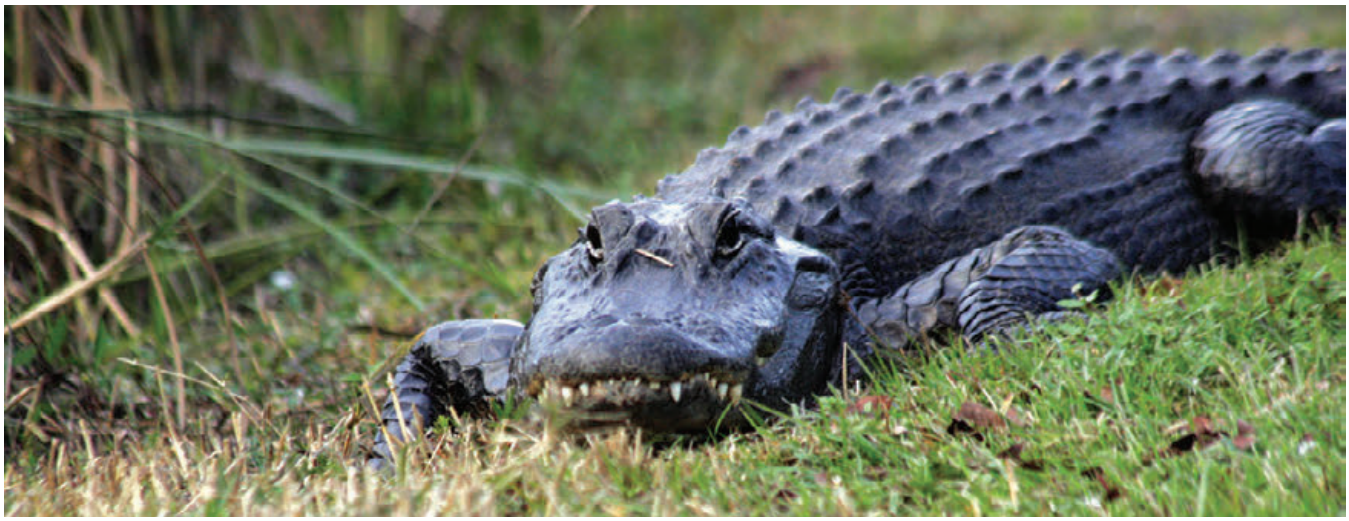

Figure 6. American alligator.

The Marjory Stoneman Douglas Wilderness has an amazing abundance of unique natural features, and these features are the primary reason the area was established as a national park. As President Truman stated during his dedication speech (1947), "Here are no lofty peaks seeking the sky, no mighty glaciers or rushing streams wearing away the uplifted land. Here is land, tranquil in its quiet beauty, serving not as the source of water but as the last receiver of it." The headwaters of the Everglades, originating in central Florida, are generally considered to lie in Shingle Creek, some 170 miles north of the wilderness' northernmost boundary. From this point, water, the lifeblood of the Everglades, flows ever so slowly southward, gradually expanding laterally across much of the state, permeating the natural features traditionally associated with this iconic landscape. It is a subtle place where earth, water, and sky blend in a low green landscape, where mere inches of elevation produce substantial changes in vegetation, and where a great wealth of birds and other wildlife find refuge.

This wilderness lies at the interface between temperate and subtropical America, sheltering a rich juxtaposition of species, many at the limit of their ranges. The interdependent mosaic of habitats supports an incomparable level of richness, ranging from microscopic organisms to matchless megafauna. Thirty-seven federally listed species have been recorded from within the wilderness, such as the American alligator (*Alligator mississippiensis*) (Figure 6) and crocodile (*Crocodylus acutus*), the Florida panther (*Felis concolor coryi*), the West Indian manatee (*Trichechus manatus*), the smalltooth sawfish (*Pristis pectinata*), and the Cape Sable seaside sparrow (*Ammodramus maritima mirabilis*). Historically, the Marjory Stoneman Douglas Wilderness was part of the most significant breeding ground for wading birds in North America. More than

Figure 7. Shark River Slough.

Figure 8. Sunrise behind Pinelands.

300 species of birds have been recorded here, seven of them rare or endangered.

Perhaps the Everglades' best-known feature, the one for which it was dubbed the "River of Grass," is a horizon-wide expanse of sawgrass prairie, punctuated by hundreds of scattered "islands." This, the largest continuous stand of sawgrass prairie in North America, characterizes the landscape over much of the interior of the wilderness (Figure 7). Within this area, the vegetation of the deeper ponds and drainage-courses includes a profusion of aquatic plants surrounded by a dense growth of willows and pond-apple trees. The small "islands" exhibit dense, low, tangled forest groves composed of the relatively few tree species that are adapted to low, swampy sites overlying deep deposits of peat. In contrast, hardwood hammocks contain a greater variety of trees that form a dense, subtropical "jungle" with tall trees and a profusion of ferns, vines, epiphytic orchids and bromeliads. More than 750 native plant species have been found within the wilderness area, including an astonishing 39 orchid and 120 tree species. Fifty-nine of the plant species within the wilderness are considered to be critically imperiled in South Florida.

The sawgrass prairie dominates the landscape, but it encompasses only one of the many diverse ecosystems found within this wilderness. Centrally located within the wilderness is a relatively small and increasingly rare ecosystem composed of pine vegetation (Figure 8). This area, known as Long Pine Key, preserves the chief surviving example in southern Florida of pine rockland and its slash-pine vegetation type. Most other examples outside of the wilderness have been destroyed and replaced as a result of human dominance over the landscape. The importance of fire in the preservation of this vegetation type is critical.

Along the western and southern fringes of the South Florida coastline, where the fresh water becomes brackish, lies the largest mangrove ecosystem in the Western Hemisphere. The coastline is cut by islands and estuaries where, in the words of President Truman, "deep rivers, giant groves of colorful mangrove trees, prairie marshes and innumerable lakes and streams" can be found. This area supports a variety of fish and wildlife, including the endangered small tooth saw fish, which is totally dependent upon the aquatic medium of these fresh-to-brackish waters.

To the west, beyond the mangroves are the open waters of the Gulf of Mexico. To the south is the broad expanse of Florida Bay, with its numerous and scattered keys, extensive seagrass meadows, mud banks, and basins (Figure 9). The bay is a shallow depression from less than one foot to no more than 10 feet in depth. Given the shallow waters and the profusion

Figure 9. Dolphins in Florida Bay.

of motorboat use above the submerged marine land wilderness, seagrass scarring from vessel groundings is a continuous threat to this resource. While not included in the wilderness designation, the water column, in combination with the submerged vegetation in this warm, favorable environment, produces food for a large and diverse population of fish and birds. The shallow grass-and-mud banks are submerged at high tide to a depth of about 2 feet. However, during low tide, some are partially exposed, providing a primary feeding ground for certain wading birds, as well as pelicans, eagles, and ospreys. The keys of Florida Bay are low islands, usually ringed with mangrove trees and supporting a variety of tropical hardwoods, shrubs, and grasses within their interior. Many species of birds utilize the various keys for roosting and nesting.

Though unique and diverse, the Marjory Stoneman Douglas Wilderness faces a number of threats, both internal and external, that diminish the Natural Quality of wilderness character. The composition of natural communities within the wilderness is threatened by a long-term disruption of the natural fire regime, as well as an abundant variety of nonnative plants and animals. The continued presence of such invasive species as the Burmese python and melaleuca (Australian paperbark tree) severely alters the structure and function of the ecosystem (Figure 10). Major changes to the hydrologic regime of the park, beginning more than 100 years ago, are the result of the construction of a vast and effective system of canals, levees, weirs, and pumps located outside park boundaries. This water management system provides flood protection and water supply to the agricultural and urban areas of South Florida. However, disruption of the quality, quantity, timing, and duration of water within the wilderness has had dramatic and lasting effects upon the landscape's form, function, and species composition, on both small and large scales. Some of these changes have resulted in the risk of losing valuable species, such as the Cape Sable seaside sparrow. Vegetation loss has occurred in Florida Bay, where many annual boat grounding and propeller-scarring incidents from motorboat use and increased salinity from diminished freshwater flows has damaged seagrass beds in submerged marine land wilderness. In the coming decades, the large-scale threats imposed by climate change and sea-level rise also have the potential to reshape the wilderness as we know it.

The importance of this environment cannot be denied. It is extremely dynamic by nature and not intended to be frozen as a static landscape. This dynamism, including the striking contrasts of land and sea, fresh water and saltwater, excess rainfall and drought, fire and the absence of fire, stormy weather and calm weather, has created an environment both fascinating and beautiful.

Figure 10. Nonnative species Burmese python (left) and Brazilian pepper (right) present in Everglades National Park.

UNDEVELOPED

Definition: Wilderness retains its primeval character and influence and is essentially without permanent improvements or modern human occupation.

As the largest designated wilderness area east of the Rocky Mountains, the Marjory Stoneman Douglas Wilderness has the appearance and feel of an undeveloped wilderness landscape, a place "where man himself is a visitor who does not remain." Sweeping views across the Everglades are largely unobstructed by human developments, allowing spectacular sights of the region's unique flora and fauna. The southern portion of the park is dotted with remote keys, few of which have experienced modern development. The interior reaches of the wilderness are largely inaccessible, deterring the desire and feasibility of any form of modern improvement.

When compared to adjacent lands to the east, there is a stark contrast between the wilderness boundary and the sprawling urbanization and development which saturates the area. This contrast makes the undeveloped landscape that much more apparent to the casual observer. Historic development within the modern wilderness boundary was largely prevented by the vast shallow waters and extreme weather characteristic of the region. However, some pre-designation developmental traces do exist, including hunting camps and inholdings within the East Everglades Addition, areas of past agricultural activity, and canals constructed in the early twentieth century. The canals, particularly those on Cape Sable, pose difficult management issues with regards to preserving wilderness character, and have resulted in the construction of artificial plugs designed to assist in the preservation of the Natural Quality (Figure 11).

For the most part, agency authorized actions within the wilderness that impact the Undeveloped Quality take one of two forms—installations and use of motorized equipment (including airboats and landing of aircraft such as helicopters). The use of these measures, although generally prohibited by section 4c of the Wilderness Act, is largely owing to a paradox inherent in the preservation of wilderness character. Installations that support scientific inquiries or park communications degrade the Undeveloped Quality but also provide information that is essential in protecting and enhancing the Natural Quality. The data gained from many scientific installations are often the best available indicator of the condition of the Natural Quality. This is particularly true of data collected in connection with ongoing environmental restoration efforts in South Florida. Data collected for this purpose are crucial to park management when negotiating with stakeholders at the landscape level, many of whom have priorities that differ from the park's goal of enhancing the Natural Quality. Furthermore, because of the expansive nature of the wilderness, combined with its extreme environmental conditions, much of the wilderness is inaccessible by traditional means within the requisite constraints of most data collection efforts. This has led to continued large-scale use and landing of helicopters within the wilderness. Airboats are also

Figure 11. Canal plug located at East Cape Sable.

extensively used primarily along existing trails, although off-trail use may be permitted in some circumstances (Figure 12). This leads to the creation and perpetuation of features that could be considered equivalent to temporary roads. Other forms of temporary roads can be found in the Long Pine Key area where fire breaks form a network of paths throughout the area.

Limited infrastructure can also be found within the marine environs of the wilderness. Through the special designation of submerged marine land wilderness, Congress authorized the continued use of motorboats within the waters that overlie these lands. Dredged channels and various aids to navigation facilitate safe boating operations within these areas and reduce the occurrence and spread of resource damage from grounding impacts because of the shallow waters of Florida Bay, Ten Thousand Islands, and mangrove backcountry areas inland from the Gulf of Mexico. Similarly, hiking and canoe trails in other portions of the wilderness are periodically cleared and utilize small markers to accomplish similar goals.

Figure 12. Park ranger on an airboat.

On balance, the individual installations that occur within this wilderness are generally small and largely unnoticeable. While helicopter use often pervades the wilderness, its effects are typically isolated and short-lived. As long as the restoration effort is ongoing in South Florida, impacts upon the Undeveloped Quality can be expected. These impacts are generally acceptable in the short term so long as managers strive to minimize the threat imposed by cumulative impacts.

SOLITUDE OR PRIMITIVE AND UNCONFINED RECREATION

Definition: Wilderness provides outstanding opportunities for solitude or a primitive and unconfined type of recreation. This quality is primarily about the opportunity for people to experience wilderness and is influenced by settings that affect these opportunities.

The ecological diversity of the Marjory Stoneman Douglas Wilderness provides an equally diverse array of recreational opportunities. Visitors to this wilderness can experience solitude, a deep connection with nature, discovery, revitalization, freedom from the pressures of society, or personal challenge and self-reliance. When delivering the invocation at the dedication ceremony for the park, Deaconess Harriett Beadell referred to this area as "a haven not only for the wild life, but where [visitors] may find the beauties and peace of nature—where they may go apart from the hurry and anxieties of this life." More than one million visitors visit Everglades National Park annually, but the vast majority never leave the few access roads or developed trails within the park to enter the wilderness.

Located adjacent to the sprawling Miami metropolis and within two hours of many other municipalities, the perimeter of the wilderness is widely accessible, and experiences can vary as much as the visitor themselves. This is a particularly challenging environment for self-reliant recreation, and it provides a unique blend of risks and hazards that contribute to the wilderness experience. Hiking and "slogging" opportunities are boundless. Visitors can depart the road constrained only by the challenges of the wilderness environment itself, including jagged pinnacle rock, deep peat, dense vegetation, and perilous wildlife—all while being surrounded by and immersed in water. Likewise, there are nearly endless opportunities for unconfined paddling. Marked canoe trails do exist, but visitors are not restricted to their confines and may explore at their leisure. Paddling coastal areas among the mangroves can provide some of the richest experiences found in this wilderness.

Although paddlers may choose to spend the night in their watercraft, primitive camping is generally limited

Figure 13. Double chickee.

to designated backcountry campsites to preserve the Natural Quality. These sites also require a backcountry camping permit to resolve capacity issues. Primitive campsites include beach and other ground sites, but the most numerous sites come in the form of "chickees"—elevated camping platforms strategically placed throughout the submerged marine wilderness areas (Figure 13). Chickees constitute visitor use facilities in wilderness, but their use is justified by two considerations. First, this watery wilderness is expansive; fully accessing it by primitive forms of transportation would not be possible without high and dry waypoints at which to stop for the night. Second, much of the coastline is dominated by mangroves. These areas are not suitable for ground camping and clearing them for that purpose would significantly impact both the Natural and Untrammeled Qualities.

Backcountry camping provides opportunities to experience a side of the wilderness that cannot be encountered during daylight hours. In contrast to urbanized areas in which many visitors reside, the wilderness provides relatively clear viewing of the night sky with little haze and light pollution that plagues many cities. For those who rarely depart metropolitan confines, the enormity and stark contrast of the night sky can be striking. Furthermore, the nighttime soundscape provides an eclectic array of chirps, croaks, grunts, and bellows that can be both fascinating and eerie in the absence of light. With morning comes the sunrise and the dance of color low across the vast horizon, rejuvenating the day as well as any who observe it. These settings provide an opportunity for self-reflection and can lead to revelations regarding significance and self-worth.

Visitors will find ample opportunities to experience solitude when recreating in this wilderness (Figure 14). If they so wish, they can lose themselves in the vastness, avoiding contact with others for days at a time. Here visitors have the opportunity to commune with nature on a fundamental level unlike anywhere else. Whether secluded in a hardwood hammock as a flock of wading birds flies low overhead, every beat of their wings heard on the wind, or drifting along surrounded by a tangle of mangrove trees consumed by the tranquil sounds of nature, this wilderness provides settings that allow the burdens of everyday life to fade away. Visitors can return home with a refreshed spirit and a greater appreciation of the majesty and beauty that lies within this wilderness.

Figure 14. Paddler at sunset.

Even so, visitors will almost certainly encounter some actions and practices that diminish this quality. Reminders of modern civilization (e.g., installations, structures, use of motorized equipment, landing of aircraft) affect the setting visitors associate with the wilderness, regardless of the utility these tools have for preserving other elements of wilderness character. The visual and auditory presence of motorboats, although allowed above the submerged marine land wilderness, influences the wilderness setting, as does the occurrence of routine aircraft overflights and specialized helicopter operations, which are typically authorized for research and monitoring. Airboat use for research, monitoring, law enforcement, and recreation (the latter limited to portions of the East Everglades Addition) also impacts opportunities for solitude. The impacts of these motorized activities can be difficult to ignore. Likewise, "chickees" affect both the natural setting and recreational experience, despite having become part of the Everglades culture and an expected part of the visitor experience. The very duality of this quality (i.e., solitude and primitive/unconfined recreation) can often be at odds. Wilderness camping permits and designated campsites impose a confinement upon recreation but help facilitate opportunities for solitude. Appropriate management of this quality, as with the other qualities, requires a delicate balance of action and restraint.

OTHER FEATURES OF VALUE

Definition: This quality covers those values and features that are not fully covered in the other four qualities, including ecological, geological, scientific, educational, scenic, or historical value. This feature is unique to an individual wilderness based on the features that are inside that wilderness.

Native Americans have interacted with and shaped this landscape for more than 5,000 years. The earliest known human occupation within this area took place on interior tree islands and hardwood hammocks. In the Ten Thousand Islands region, humans constructed many of today's land-based islands from shell debris, primarily oyster shells. Over time, the accumulation of debris (shell and soil middens) as well as the intentional construction of raised platforms, ridges, high mounds, crescents, canals, and inundated courtyards have significantly altered the topography of these locations. These human-constructed landscape elements support numerous plant and animal habitats, which could not exist in their current numbers and locations without the agency of Native Americans.

The Mud Lake Canal on Cape Sable is an aboriginal canal potentially constructed as early as 1,250 years ago by ancestors of the Tequesta people and is associated with the Bear Lake Mound district. The canal extends about four miles, linking Bear Lake and the waters of Whitewater Bay with Florida Bay. The prehistoric canal likely provided safer navigation passage, easy access to aquatic resources, and a route to facilitate exchange and tribute among groups. The canal was designated a National Historic Landmark in 2006, exhibiting exceptional national significance as the best-preserved example of a rare prehistoric engineering feature.

More recently, human interaction with the wilderness includes exploration and recreation; subsistence activities; resource extraction; agricultural undertakings; homesteading; engineered canals; military excursions (with associated development of camps and forts); large-scale hydrological modifications and ecological restoration. It is noteworthy that the remains of the thousands of people who lived and died in the wilderness are still present in burial mounds, cemeteries, and burial grounds. Human presence upon this landscape is integral to fully understanding and defining this wilderness.

Up to the establishment of the Everglades National Park in 1947, Native Americans who identify today with the Miccosukee Tribe of Indians of Florida, Seminole Tribe of Florida, Seminole Nation of Oklahoma, Council of the Original Miccosukee Simanolee Nation Aboriginal Peoples, and Independents were living in camps and practicing traditional activities. After establishment of the park, there was a decline in the Native American presence, but traditional activities continue into the present. These traditions included arts, crafts, social institutions, hunting, fishing, gathering plants,

practicing religious ceremonies and burying their dead in the wilderness. The land and resources comprising the wilderness are linked to their cultural practices and beliefs. To Native Americans the landscape holds deeply embedded heritage values important in maintaining and continuing the group's cultural identity.

Based upon documented activities within the wilderness, historical archeological resources include fishing and hunting camps, fish processing facilities and ice plants, tannic acid plants, charcoal production sites, road construction camps, military outposts, sugar cane mill sites, farmsteads, private recreational development, homesteads, ecological restoration, and oil exploration sites. Archeological features associated with historic sites include the remnants of houses, outbuildings, cisterns, and gardens. Associated artifacts commonly include ceramic and glass fragments, metal hardware, tools, and personal items. The location, integrity, and cultural significance of most of these historic archeological resources are currently unknown.

In the early 1900s, canals were constructed as part of the draining of the landscape for agricultural purposes and permanent settlement of the area. These canals were plugged in the 1950s and 1960s as part of the ecological restoration of the wilderness environment.

In East Everglades, several hunting camps (including bunkhouses, sheds, outhouses, and other features) are present on interior tree islands and hardwood hammocks. One example is Duck Camp, constructed around 1950, which was formerly used by the Miami Rod and Gun Club.

Threats to other cultural resources that contribute to this quality include weathering, vandalism, sea level rise, and park management actions, including those associated with Everglades restoration.

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WILDERNESS CHARACTER MONITORING BASELINE ASSESSMENT

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WILDERNESS CHARACTER MONITORING BASELINE

This wilderness character monitoring baseline assessment describes the wilderness character monitoring strategy for the Marjory Stoneman Douglas (MSD) Wilderness and other lands managed as wilderness at Everglades National Park based on the monitoring framework of *Keeping it Wild 2*. It discusses the measures identified by an interdisciplinary team for monitoring and provides quantitative baseline data for each. In contrast to the qualitative descriptions found in the wilderness character narrative, this is a quantitative assessment of the area's wilderness character. While the wilderness character qualities, monitoring questions, and indicators are nationally consistent, measures are specific and sometimes unique to Everglades National Park to reflect the singularity of the park's wilderness areas. The measures selected, and the corresponding data compiled and analyzed for each, establish a foundation for continued monitoring of wilderness character into the future.

PROCESS USED FOR IDENTIFYING MEASURES

The process used to identify and select measures to monitor wilderness character is outlined below.

Gather information—Background information was gathered to better understand the wilderness and its history, ecosystems, and potential future threats. Information was sourced from background and guiding documents for the wilderness and park and interviews by the park's Wilderness Fellow with local staff.

Create list of possible measures—Preliminary measures were identified and compiled by the Wilderness Fellow for all indicators based on the information gathered and interviews with local staff. Several measures were based on measures described in wilderness character monitoring documents, such as the *Forest Service Technical Guide*, or measures developed for other wilderness areas and adapted to suit the MSD Wilderness and other lands managed as wilderness at Everglades National Park.

Conduct wilderness character assessment and internal scoping workshop—Preliminary measures were discussed at the 2016 Wilderness Character Assessment and Internal Scoping Workshop with approximately 25 park staff members. Break-out groups for each wilderness character quality were formed, and measures were added or eliminated.

Refine measures—Measures were prioritized and refined through discussing measures with staff. This work was initially carried out by the Wilderness Fellow following the workshop and has been completed by park staff. Generally, the measures represented in this report are those for which data currently exists or data would be feasible to collect in the future with existing resources.

Locate and synthesize data—Available data for each measure were collected by contacting relevant individuals and pulling information from national databases, shared drives, and GIS or paper files. Data were processed and analyzed as necessary. This work was initially carried out by the Wilderness Fellow following the workshop and has been completed by park staff.

Write report—Background information, collection protocol, data adequacy, data source, and meaningful change were described for each measure. This work was initially carried out by the Wilderness Fellow following the workshop and has been completed by park staff.

Incorporate comments—Changes, edits, and feedback from local staff were received, and edits were incorporated into the final draft. This work was initially carried out by the Wilderness Fellow following the workshop and has been completed by park staff.

Approval of final report—Report was finalized and submitted to the park management team for review and approval by the park superintendent.

OVERVIEW OF WILDERNESS CHARACTER MONITORING MEASURES

Table 1 below provides a basic overview of the 18 wilderness character measures selected for monitoring the MSD Wilderness and other lands managed as wilderness at Everglades National Park. Each measure is described in more detail in its respective section later in the report.

Table 1. Wilderness Character Monitoring Measures for the MSD Wilderness and Other Lands Managed as Wilderness at Everglades National Park

Wilderness Character Quality	Indicator	Measure
Untrammeled	Actions authorized by the federal land manager that intentionally manipulate the biophysical environment	Number of authorized actions and persistent installations designed to manipulate plants, animals, pathogens, soil, water, or fire
Untrammeled	Actions not authorized by the federal land manager that intentionally manipulate the biophysical environment	No measure selected
Natural	Plants	Index of priority invasive plant species Total length of propeller scarring of seagrass in Florida Bay
Natural	Animals	Presence of nonnative fishes
Natural	Air and water	Haze on mid-range days Concentration of nitrogen in wet deposition Concentration of sulfur in wet deposition
Natural	Ecological processes	Index of total phosphorus concentrations in periphyton Percentage of acres within the maximum expected fire return interval
Undeveloped	Presence of non-recreational structures, installations, and developments	Index of non-recreation physical developments
Undeveloped	Presence of inholdings	Number of inholdings
Undeveloped	Use of motor vehicles, motorized equipment, or mechanical transport	Index of authorized use of motor vehicles, motorized equipment, and mechanical transport
Solitude or Primitive and Unconfined Recreation	Remoteness from sights and sounds of human activity *inside* wilderness	Acres of wilderness away from access and travel routes and developments inside wilderness
Solitude or Primitive and Unconfined Recreation	Remoteness from sights and sounds of human activity *outside* the wilderness	Acres of wilderness away from adjacent travel routes and developments outside wilderness Night sky visibility
Solitude or Primitive and Unconfined Recreation	Facilities that decrease self-reliant recreation	Number of authorized constructed or improved recreation features
Solitude or Primitive and Unconfined Recreation	Management restrictions on visitor behavior	Index of visitor use management restrictions
Other Features	Deterioration or loss of integral cultural features	Number of shell works that have received a "poor" condition assessment since wilderness designation

For each measure, this report includes the following subsections: measure baseline data value, current data value, year(s) of data collection, definitions, background and context, measure description and collection protocol, data source, data adequacy, data frequency, and meaningful change. The content and purpose of each of these subsections is described below.

Measure Baseline Data Value. This subsection specifies the earliest data value that exists for a measure. Historical data used for a measure can include any data collected from 1978 (the year of wilderness designation) onward. Trends for each measure are calculated by comparing the most recent data value with the measure baseline data value, or by a regression analysis of all data values for a measure. The value in the parenthesis specifies the year(s) the data were collected. If the measure baseline data value represents a multiyear average, the range of years will be specified. The measure baseline data value should be calculated considering only wilderness that existed at the year(s) the data were collected and not wilderness that was been added later.

Current Data Value. This subsection specifies the most recent data value available for a wilderness. In many cases, the current data value is collected for the previous year (i.e., 2020), but at times, the most recent data value may be collected at an earlier date (e.g., national air quality data are often published on a 2-year delay). If the current data value is the first data value for a measure, **Current Data Value (Measure Baseline)** is used in place of "Measure Baseline Data Value" and "Current Data Value." The value in the parenthesis specifies the year(s) the data were collected. If the current data value represents a multiyear average, the range of years will be specified.

Background and Context. This subsection describes the context and relevance for the measure at an individual wilderness and addresses why the measure was selected.

Measure Description and Collection Protocol. This subsection describes what is being measured and how, including the process through which data is compiled or gathered. "Collection protocol" is defined and used in this document to refer to the process by which data are gathered from existing sources and does not include in-the-field data collection instructions. If field data collection protocols are relevant to a measure and available, a location of where the protocol can be found is included. Additional instructions for completing GIS analyses and simple linear regressions accompany this report as separate documents. Appendix B provides a summary of effort required for wilderness character monitoring. Appendix C provides a brief summary of the data sources and collection protocols for each measure.

Data Source. This subsection describes where baseline information and any historical data for the measure can be found in the future. The intent of this section is to encourage written documentation of wilderness character data and data sources so that information is accessible into the future.

Data Adequacy. This subsection defines the reliability of the data to assess trends in the measure. Data adequacy is based on both data quantity and data quality. Data quantity refers to the level of confidence that all appropriate data records have been gathered. Data quality refers to the level of confidence about the source(s) of data and whether the data are of sufficient quality to reliably identify trends in the measure. Further information on the role of data quantity and quality in wilderness character monitoring is available in the *Forest Service Technical Guide* (Landres et al. 2009, p. 26). These two aspects of data adequacy are subjectively evaluated according to the categories described in Table 2. Data adequacy (scored as high, medium, or low) must be determined on a case-by-case basis from the assessments of data quality and quantity; however, a general scoring framework can be used as a starting point for this determination (Table 3).

Table 2. Data Quantity and Quality Definitions

Data Quantity	Data Quality
Complete—This category indicates a high degree of confidence that all data records have been gathered. For example, to assess the occurrence of nonindigenous plants, a complete inventory of the wilderness was conducted, or all likely sites were visited. Similarly, to assess encounters, all trailheads were inventoried.	**High**— This category indicates a high degree of confidence that the quality of the data can reliably assess trends in the measure. Data are highly accurate, reliable, and relevant for the measure. For example, data on the occurrence of nonindigenous plants are from ground-based inventories conducted by qualified personnel.
Partial—This category indicates a moderate degree of confidence that all data records have been gathered. Some data are available but are generally considered incomplete, such as with sampling. For example, to assess the occurrence of nonindigenous plants, only a partial inventory was conducted; to assess encounters, only selected trailheads were sampled.	**Moderate**—This category indicates a moderate degree of confidence about the quality of the data. Data are only moderately accurate, reliable, or relevant. For example, data on nonindigenous plants could come from national or regional databases; for encounters, data could come from visitor permit data.
Insufficient—This category indicates a low degree of confidence that all records have been gathered. Few or no data records are available, or the measure is not dependent on actual field data. For example, no inventory for nonindigenous plants has been conducted, and encounters were not assessed anywhere.	**Low**—This category indicates a low degree of confidence about the quality of the data. The accuracy, reliability, or relevancy of the data is minimal or unknown. For example, data on nonindigenous plants and encounters data could come from professional judgment.

Table 3. Suggested Scoring for Data Adequacy

Data Quantity	Data Quality	Data Adequacy
Complete	High	High
Complete	Moderate	Medium
Complete	Low	Medium
Partial	High	Medium
Partial	Moderate	Medium
Partial	Low	Low
Insufficient	High	Medium
Insufficient	Moderate	Low
Insufficient	Low	Low

Data Frequency. This subsection states how often data for this measure should be entered into the Wilderness Character Monitoring Database. Frequency is typically determined by the timeframe in which data become available under existing monitoring protocols for use in wilderness monitoring purposes.

Meaningful Change. This subsection defines how much the data must change to indicate a changing trend in the measure.

Together, these subsections provide a comprehensive overview of each measure, provide transparency into the wilderness character monitoring measures selected, and form the basis of the wilderness character monitoring strategy for the MSD Wilderness and other lands managed as wilderness at Everglades National Park.

UNTRAMMELED QUALITY

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UNTRAMMELED QUALITY

Wilderness is essentially unhindered and free from modern human control or manipulation.

The objective of monitoring the Untrammeled Quality is to assess whether management of a wilderness is trending over time toward more or less human manipulation of plant communities, fish and wildlife populations, insects and disease, soil and water resources, and fire processes. This monitoring focuses on both authorized actions and unauthorized actions that intentionally control or manipulate "the earth and its community of life" within wilderness.

Section 2(c) of the Wilderness Act defines wilderness as "an area where the earth and its community of life are untrammeled by man," that "generally appears to have been affected primarily by the forces of nature" and is an area "retaining its primeval character and influence." The American Heritage dictionary (1992) defines the term untrammeled as "allowed to run free," and synonyms include unrestrained, unrestricted, unhindered, unimpeded, unencumbered, and self-willed. In his testimony at the Wilderness Act's final Senate hearing, Zahniser (1963) stated that in the bill's definition of wilderness, "…the first sentence [on untrammeled] is definitive of the meaning of the concept of wilderness, its essence, its essential nature…The first sentence defines the character of wilderness." Measures under the Untrammeled Quality monitor the extent to which wilderness is unhindered and free from the intentional actions of modern human control or manipulation.

The Untrammeled and Natural Qualities are closely related, though they differ in a key way—the Untrammeled Quality monitors actions (including persistent installations) taken that intentionally control or manipulate ecological systems inside wilderness, whereas the Natural Quality monitors the effects on these systems from actions taken inside wilderness or from external forces regardless of intent. Separating actions from effects offers a clearer understanding of the trends in each, and a more effective analysis to improve wilderness stewardship.

A single monitoring question is used in monitoring the Untrammeled Quality: What are the trends in actions

that intentionally control or manipulate "the earth and its community of life" inside wilderness? This monitoring question examines actions that intentionally control or manipulate the components or processes of ecological systems inside wilderness.

Actions that degrade the Untrammeled Quality are typically the result of decisions by the agency. However, intentional activities by other Federal and State agencies, non-governmental organizations, the public, or even other branches of the National Park Service that are not authorized by the park unit charged with managing the wilderness may also affect this quality.

Generally, two indicators are used to understand the monitoring question—one that addresses intentional manipulations that are authorized by the managing park unit and another that addresses intentional manipulations that are not authorized by the managing park unit. However, park staff have chosen to exclude the second indicator because unauthorized trammeling actions are difficult to detect and document in a reliable manner. For additional details on this decision, see the description section of the second indicator, "Actions not authorized by the federal land manager that intentionally manipulate the biophysical environment" below.

Table 4 shows all measures selected to monitor the Untrammeled Quality in the MSD Wilderness and other lands managed as wilderness at Everglades National Park. The measures are also described in detail below.

Table 4. Measures Selected for the Untrammeled Quality

Indicator	Measure	Frequency in Years	Data Adequacy	Meaningful Change	Baseline Data Value (Year)	Current Data Value (Year)
Actions authorized by the federal land manager that intentionally manipulate the biophysical environment	Number of authorized actions that manipulate plants, animals, pathogens, soil, water, and fire.	1	Medium	5% change in number of actions (3 year rolling avg.) Regression analysis after 5 values	60.6 (2019)	60.6 (2019)
Actions not authorized by the federal land manager that intentionally manipulate the biophysical environment	*No measure selected (see section below for rationale)*	N/A	N/A	N/A	N/A	N/A

NPS Photo

UNTRAMMELED QUALITY

Actions authorized by the federal land manager that intentionally manipulate the biophysical environment

This indicator tracks all significant actions authorized by Everglades National Park that intentionally manipulate the biophysical environment, including those allowed under section 4(d)(1) of the Wilderness Act (which states "measures may be taken as may be necessary in the control of fire, insects and disease, subject to such conditions as the Secretary deems desirable"). Intentional manipulations taken by other federal agencies, state and tribal agencies, and private citizens are included under this indicator if these actions are authorized by Everglades National Park. Trend in this indicator tracks whether or not managers are practicing restraint to allow a wilderness area to persist in its free and self-willed condition.

Number of Authorized Actions and Persistent Installations Designed to Manipulate Plants, Animals, Pathogens, Soil, Water, or Fire

Measure Baseline Data Value: 60.6 (2019)

Current Data Value: 60.6 (2019)

Definitions:

- ***Installation***—anything made by humans that is not intended for human occupation and is left unattended or left behind when the installer leaves the wilderness.
- ***Persistent Installation***—an installation in place for a prolonged period of time (greater than one year) intended to purposefully alter, hinder, restrict, control, or manipulate "the earth and its community of life." Examples include, but are not limited to fish barriers, dams, water diversions, guzzlers, bat gates, or fencing.

Background and Context:

This measure speaks directly to the indicator by counting all significant actions authorized by Everglades National Park that intentionally manipulate the biophysical environment within wilderness. It does not parse trammeling actions for different programs or activities and counts all trammeling actions equally under a single measure.

A variety of trammeling activities frequently occur within wilderness. First, the subtropical climate of South Florida is a haven for nonnative species; the MSD

Wilderness and other lands managed as wilderness at Everglades National Park are no exception. This has resulted in the continuous need to manage the spread of these species to battle their impacts upon the natural environment. Second, as a result of past water drainage and environmental damage, the Everglades ecosystem has been heavily impacted. This has resulted in extensive restoration efforts both inside and out of the wilderness to enhance the long-term sustainability of the Everglades ecosystem. Finally, fire is a natural and critical part of the Everglades ecosystem. Prescribed fire in Everglades National Park has occurred since 1958, even before the wilderness was federally designated at the park. Prescribed fires help restore and maintain the wet prairies and sawgrass marshes located heavily throughout the wilderness areas (Figure 15). These landscape-scale prescribed burning projects are necessary because natural historic fire spread is limited due to anthropogenic development and habitat fragmentation. Additionally, natural ignitions are sometimes suppressed due to concerns for human safety, endangered species habitat, park infrastructure and resource values, and proximity to private property. While these actions have many ecosystem benefits and enhance the Natural Quality of wilderness character, any action taken to manipulate the biophysical environment, even when beneficial to other qualities, is considered a trammeling action and degrades the Untrammeled Quality of wilderness character.

Figure 15. Prescribed burn in coastal prairie.

Measure Description and Collection Protocol:

This measure assesses the three-year rolling average of authorized trammeling actions, based on an annual count of authorized actions and persistent installations intended to manipulate any component of the biophysical environment within wilderness (including vegetation, fish, wildlife, insects, pathogens, soil, water, or fire).

Step 1 is to ensure users understand what constitutes authorized trammeling and then compile data. Detailed information about how to determine what is, is not, and may be a trammeling action, including numerous examples, can be found in appendix D. Additional information can be found in Appendix 6 (pg. 101) of *Keeping It Wild 2*. This measure includes discretionary and non-discretionary actions required to uphold Federal law, including those explicitly allowed under the Wilderness Act and subsequent wilderness legislation. Intentional manipulations taken by other Federal agencies, tribal or State agencies, organizations, and private citizens are also included under this measure if these actions are authorized by Everglades National Park. This includes actions authorized through special use permits or other instruments (e.g., research permits, contracts, agreements).

Step 2 is to count the number of authorized trammeling actions that occurred during the fiscal year (Table 5). The counting protocol for authorized trammeling actions is as follows, with counting instructions grouped in categories including scale of action, timing of action, location of action, firerelated actions, persistent installations, and other clarifications:

Number of Actions:

- Single projects or decisions that involve related, yet distinct, actions count as multiple trammeling actions. For example, a stream restoration project that involves both the release of piscicide and restocking native fish count as two trammeling actions. Treating one or more species of invasive plants with herbicide and a biological control agent also count as two trammeling actions—one action for the use of herbicide, and one action for the release of the biological control agent. The number of species affected by each treatment is incidental.
- Updating a contract to take additional actions would be counted as a new decision and therefore a new action.

Scale of Action:

- Only count actions that are of sufficient scale to qualify as trammeling actions for practicable monitoring, as described in appendix D. For instance, hand pulling a small number of invasive plants, removing a downed tree across a trail, or restoring a campsite may be considered below the threshold for practical monitoring, and thus would not be counted under this measure. For each trammeling category, actions that are covered under existing environmental compliance documents but are not part of a defined contract or project will be rolled into (counted as) one action.
- All actions that meet the scale requirements for monitoring trammeling actions are counted equally, regardless of the magnitude of their effects. For instance, spraying herbicide on a small population of noxious weeds is equivalent to spraying herbicide across 1,000 acres. Likewise, an herbicide treatment of weeds targeting one species is equivalent to an herbicide treatment targeting five species simultaneously.
- Actions that are individually too small in scale to be counted as trammeling actions are considered a trammeling if their cumulative effects crossed the threshold described in *Keeping It Wild 2*. For instance, removing a single hazard tree in a campsite is not considered a trammeling. However, an insect or disease event that killed many trees in an area with many campsites and resulted in the removal of a large number of hazard trees could be considered a trammeling. The Park's Wilderness Coordinator will use their discretion and judgment in determining when cumulative effects cross the threshold resulting in a series of otherwise minor actions constituting a trammeling, including whether subsequent yet discrete actions add to these cumulative effects and constitute additional trammeling actions.

Timing of Action:

- Ongoing, multiyear actions are counted once annually per fiscal year.
- A single action that incidentally spans the fiscal year is only counted as a trammeling action for the initial fiscal year. For example, an exotic vegetation treatment project implemented between September 15 and October 15, 2018, counts as one action for fiscal year 2018 and zero actions for fiscal year 2019.

Location of Action:

- The decision to take an action that occurs simultaneously in multiple locations in a wilderness is counted as a single action. For example, treatments of discrete exotic species populations located in different areas using herbicide counts as a single action. Similarly, concurrently stocking fish in multiple lakes across a wilderness counts as a single trammeling action. However, users must ensure that similar, concurrent actions occurring at multiple locations are not part of two separate decision processes or authorizations (i.e., two distinct opportunities to show restraint) - for example, invasive plant removal at two separate locations within the wilderness by the same contractor but awarded through two separate contracts or by modification of an existing contract.
- Actions that occur outside of wilderness with the explicit intent of manipulating the biophysical environment within wilderness count as trammeling actions.

Fire-Related Actions:

- Individual wildfire incidents—whether naturally ignited or human-caused—count as a single trammeling action for each distinct action (i.e., incident) in which a wildfire was actively suppressed, either full (Full Suppression) or in part (Confine/Contain).
- Partial suppressions (i.e., actions in which portions of a wildfire are suppressed in order to protect at risk resources) are counted equally as fully suppressed wildfires. However, there are thresholds below which a partial suppression would not be counted. Note, existing data does not differentiate these thresholds, but new data sources will (i.e., InFORM)). Considerations include:
    - Trammeling action—use of the confine/contain strategy to manipulate the direction of the fire (e.g., preventing fire from spreading into critical habitat for an endangered species).
    - Not a trammeling action—point protection where action is taken to protect a specific asset or resource without directly halting continued fire spread. Note, the baseline may need to be reevaluated if a significant number of point protection actions are recorded in the near future.

- Suppression of a wildfire on park property that is adjacent to but outside of wilderness constitutes a trammeling action due to the potential for fires to spread into wilderness if left unsuppressed. Since 97% of Everglades National Park is managed as wilderness, all wildfires occurring on park lands that receive a suppression response, unless noted elsewhere, should be counted regardless of location. Fires occurring on Miccossukee Reserve Lands are excluded.
- The use of prescribed fire counts as a single trammeling action because of the decision to intervene in natural processes in accordance with the management prescription. The implementation of multiple prescribed fires in a wilderness count as a trammeling action for each burn implemented. While the application of multiple prescribed fires is oftentimes approved through a single burn plan, the decision to burn each individual location offers an opportunity for restraint.
- Prescribed fires planned to occur entirely outside of wilderness boundaries (e.g., roadside burning) would not be counted as a trammel.
- Prescribed fires that occur on different days but can be reasonably attributed to the same planned burn, count as a single trammeling action.
- Fire break clearing and maintenance that can be attributed specifically to a prescribed fire would be counted as part of that burn operation.
- Establishment and long-term maintenance of fire breaks for wildfire preparedness actions, count as separate trammeling actions for each fiscal year in which they are maintained. Maintenance of visitor trails used as fire breaks would not count as a trammeling action unless clearing exceeds the desired conditions for the trail being cleared.

Persistent Installations:

- To be counted as a trammeling action, a persistent installation must be intended to purposefully alter, hinder, restrict, control, or manipulate "the earth and its community of life." Examples of persistent installations that would be counted under this measure include, but are not limited to, fish barriers, dams, water diversions, guzzlers, bat gates, or fencing (e.g., wildlife or cattle enclosure or exclosure areas). Unless otherwise noted, each unique persistent installation that manipulates any component of the biophysical environment is counted for each year that it exists and remains functional.
- An action to install a persistent installation that alters the biophysical environment in wilderness is counted once as a trammeling in the year that the installation occurred and once per year subsequently, as long as the installation persists. The construction and existence of the installation in the first year are not double counted as two trammeling actions.
- Maintenance of an installation to ensure it persists in its intended form does not count as a separate trammeling action unless the installation was present prior to wilderness designation and is actively maintained to ensure the manipulation continues. In this case, the persistent installation is counted once as a trammeling in the year that post-designation maintenance initially occurs and once per year subsequently, as long as the installation persists.
- Persistent installations on the periphery of park boundaries that are intended to purposefully alter, hinder, restrict, control, or manipulate conditions within the wilderness are counted differently depending on the type of manipulation:
    - Persistent installations that are actively managed (e.g., pump stations that are actively opened and closed to manipulate hydrology) are counted in the same manner as other persistent installations.
    - Passive persistent installations (e.g., barriers that prevent water from flowing out of the park) are counted only in years they are installed or significantly altered. These installations are then subsequently counted collectively as a single trammel under the associated project for every year they persist.
- The purpose of counting persistent installations under this measure is based solely on the manipulative function of the installation rather than the existence of the installation, which is counted under the indicator *Presence of Non-recreational Structures, Installations, and Developments* within the Undeveloped Quality. Persistent installations that are no longer functioning as intended are not counted as a trammeling if it can be demonstrated they do not alter or manipulate any component of the biophysical environment (e.g., fencing previously used to form a wildlife exclosure that has fallen down). However, those installations located within wilderness would still be counted under the indicator pertaining to the Undeveloped Quality.

Other Clarifications:

- Actions intended to manipulate the biophysical environment within wilderness that are unsuccessful are still counted as trammeling actions.
- Interpretation of the number of trammeling actions associated with an action or decision may vary due to the potential complexity of determining what constitutes a trammeling action. In the event any nuanced or complex trammeling interpretations arise, the Wilderness Coordinator will document the methodology and considerations behind those decisions.
- If a project involves multiple trammeling installations that are in place for less than one year or non-continuously over several years, those installations will count as one trammeling action for each fiscal year they are in place.

Table 5. Three-Year Average (2017–2019) of Trammeling Actions Organized by Category and Type

Trammeling Categories	Type	Number
Fire Operations	Wildfire Suppression	22.6
Fire Operations	Prescribed Fire	10.3
Fire Operations	Fuels Reduction and Fire Break Management	0
Persistent Installations	Water Control Installations	8
Persistent Installations	Enclosures/Exclosures	0
Persistent Installations	Other	0
Ecological Interventions	Restoration	2.3
Ecological Interventions	Extensive Hazard Tree Removal	0
Ecological Interventions	Other	3.6
Exotic Species Removal/Treatment	Plants	5
Exotic Species Removal/Treatment	Animals	3.6
Native Species Management/Introductions	Plants	1
Native Species Management/Introductions	Animals	0
Research Activities	Temporary Enclosures/Exclosures	1.3
Research Activities	Manipulative Experimentation	2.6

Data Source:

Because of the wide variety of action types counted under this measure, there is no single source for data. The wilderness coordinator will work with park managers and park and region resource specialists (see Table 6) to compile a list of readily known actions using staff knowledge of ongoing projects as well as minimum requirements analyses (MRA), National Environmental Policy Act (NEPA) documents, PEPC projects, program summary reports, Pesticide Use Proposals, special use permits, research permits, fire burn plans, ICS-209 forms, NPS databases (e.g., PEPC, FMSS), and national databases (e.g., InFORM).

Table 6. Data Sources for Different Types of Trammeling Actions

Trammeling Categories	Type	Data Source
Fire Operations	Wildfire Suppression	Fire Management Program (see TrammelingProtocol_FireSupplement.docx)
Fire Operations	Prescribed Fire	Fire Management Program (see TrammelingProtocol_FireSupplement.docx)
Fire Operations	Fuels Reduction and Fire Break Management	Fire Management Program
Persistent Installations	Water Control Installations	SFNRC—Hydrology Branch Chief
Persistent Installations	Enclosures/Exclosures	SFNRC—Natural Resources Staff
Persistent Installations	Other	SFNRC Staff, park Cultural Resources Staff
Ecological Interventions	Restoration	SFNRC—Restoration Program Manager, Hydrology Branch Chief
Ecological Interventions	Extensive Hazard Tree Removal	Fire Management Program and Facilities Division
Ecological Interventions	Other	Fire Management Program, Facilities Division, SFNRC Staff
Exotic Species Removal/ Treatment	Plants	Invasive Plant Management Program (see yearly program summary report)
Exotic Species Removal/ Treatment	Animals	Invasive Species Biologist
Native Species Management/Introductions	Plants	Park Botanist
Native Species Management/Introductions	Animals	Biological Resources Branch Chief
Research Activities	Temporary Enclosures/Exclosures	Research Permits
Research Activities	Manipulative Experimentation (e.g., Nutrient Dosing, Hand Pollination, In situ Mesocosm Experiments)	Research Permits

Data Adequacy:

Medium—The data quantity is partial because a centralized database does not exist in which all trammeling actions are documented. In many cases it is likely that all data records related to authorized actions and persistent installations that manipulate the biophysical environment can be gathered, although this may be difficult because of the large scale of the wilderness and the number of potential data sources. The data quality is moderate because of a lack of documentation or the information was not reported. An earlier baseline data value (ca. 2014–2016) was considered based on available information. However, the fire management program was experiencing administrative issues during that time related to completion and approval of the fire management plan. A baseline value associated with this period would not have been representative of the norm. Therefore, a later baseline value was utilized for this measure to provide a more accurate comparison going forward.

Frequency:

Data are compiled and analyzed annually after each fiscal year due to the variable nature of trammeling actions.

Meaningful Change:

The threshold for meaningful change is a 5% change in the three-year rolling average number of authorized actions and persistent installations. Park staff chose a three-year rolling average to account for potential annual variability in the data set while still being able to detect subtle changes over time which may be unnoticeable by averaging over a longer timeframe. Once there are five measure values, the threshold for meaningful change will switch to regression analysis using a 90% confidence level (pvalue <0.1). A decrease in the three-year rolling average beyond the threshold for meaningful change results in an improving trend in this measure.

NPS Photo, P. Gandy

UNTRAMMELED QUALITY

Actions not authorized by the federal land manager that intentionally manipulate the biophysical environment—NOT INCLUDED AT EVERGLADES

This indicator attempts to identify all actions that have not been authorized by the park that intentionally manipulate the biophysical environment. Unauthorized intentional manipulations of plants, animals, physical resources, or biophysical processes within wilderness have the potential to affect all qualities of wilderness character. These actions are fundamentally different from those authorized by the managing agency. Most authorized manipulations undergo a review process to determine their impacts on the various resources within wilderness, but unauthorized manipulations are often undertaken with little to no consideration for their effects on the broader ecological systems within wilderness and on the other qualities of wilderness character. This indicator captures an important type of trammeling action that can have a large impact.

For this wilderness character baseline assessment, Everglades National Park staff decided to exclude this indicator because unauthorized trammeling actions are difficult to detect and document in a reliable manner. It is difficult to determine from law enforcement data if offenses were in fact (1) trammeling types of actions and (2) intended to manipulate the biophysical environment. In addition, the number of documented trammeling actions occurring outside the park that Everglades National Park did not authorize and/or support is so low that it would be difficult to discern a trend. The ambiguity of this data detracts from the more reliable authorized trammeling indicator when the trends from each indicator are rolled up to determine an overall trend for the untrammeled quality. In the future, park staff may integrate this indicator if and when more reliable data is available. Law enforcement will continue to document all unauthorized or unlawful trammeling-type activities that they observe even if they are not included in a measure.

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NATURAL QUALITY

NPS Photo, R. Hess

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NPS Photo, M. Collier

NATURAL QUALITY

Wilderness ecological systems are substantially free from the effects of modern civilization.

The objective of monitoring the Natural Quality is to assess the effects of modern civilization on the integrity of wilderness ecosystems, with a focus on plants, animals, air and water, and ecological processes. The Wilderness Act defines wilderness as an area that "is protected and managed so as to preserve its natural conditions" and that these areas should be free from the effects of "an increasing population, accompanied by expanding settlement and growing mechanization" (sections 2(c) and 2(a), respectively). Human-caused changes to wilderness ecological systems can be intentional or unintentional. While managers may have control over some impacts to natural ecosystems in wilderness, many threats come from external sources outside of their jurisdiction (e.g., air pollutants and nonindigenous species). In contrast to the Untrammeled Quality, which monitors actions that manipulate or control ecological systems, the Natural Quality monitors the effects on wilderness ecosystems from human actions and external forces. While this quality encompasses all the naturally occurring species, physical resources, and ecological functions and processes in wilderness, practical limitations require that a relatively small but important subset of possible measures are monitored.

A single monitoring question is used to monitor the Natural Quality: What are the trends in the natural environment from human-caused change? This monitoring question assesses the trends in natural wilderness ecosystems that result from human-caused threats occurring since designation of the area as wilderness. Importantly, this monitoring question seeks to distinguish between natural variability, which is integral to all ecosystems and does not degrade wilderness character, and human-caused change. To address the monitoring question, four indicators assess a range of ecosystem components, structures, and functions in wilderness: (1) plants, (2) animals, (3) air and water, and (4) ecological processes. Practical and conceptual constraints mean that not everything important to wilderness ecosystems can be included in this monitoring. The measures under each indicator are not all encompassing; rather, the measures are selected because they are known human-caused threats to the indicators.

Table 7 shows all measures selected to monitor the Natural Quality in the MSD Wilderness and other lands managed as wilderness at Everglades National Park. The measures are described in detail below.

Table 7. Measures Selected for the Natural Quality

Indicator	Measure	Frequency in Years	Data Adequacy	Meaningful Change	Baseline Data Value (year)	Current Data Value (year)
Plant	Index of priority invasive plant species	5	Medium	5% change (Total Acres) Regression analysis after 5 values	231.2 (1995)	336.2 (2015)
Plant	Total length of propeller scarring of seagrass in Florida Bay	5	Low	5% change (Scar Length) Regression analysis after 5 values	624,457.1 meters (2011)	338,023.4 meters (2016)
Animals	Presence of nonnative fishes	1	High	5% change (3 yr. rolling avg.) Regression analysis after 5 values	49.3333 (2006)	54.3333 (2017)
Air and Water	Haze on mid-range days	1	High	≥1 dv Regression analysis after 5 values	15.5 dv (2005wy)	13.7 dv (2017wy)
Air and Water	Concentration of nitrogen in wet deposition	1	High	≥0.5 kg/ha/yr Regression analysis after 5 values	2.3 kg/ha/yr (1986wy)	3.8 kg/ha/yr (2017wy)
Air and water	Concentration of sulfur in wet deposition	1	High	≥0.5 kg/ha/yr Regression analysis after 5 values	3.4 kg/ha/yr (1986wy)	3.1 kg/ha/yr (2017wy)
Ecological Processes	Index of total phosphorus concentrations in periphyton	1	High	5% change (3 yr. rolling avg.) Regression analysis after 5 values	5.3333 (2007)	3.6667 (2016)
Ecological Processes	Percentage of acres within the maximum expected fire return interval	5	High	Regression analysis	23.65% (1978)	52.45% (2020)

NPS Photo

NATURAL QUALITY

Plants

This indicator focuses on threats to indigenous plant species and communities. Indigenous plant species (also referred to as native plant species) and plant communities are an essential biological component of natural wilderness ecosystems. Indigenous plant species and communities are those that evolved in an area and therefore have intrinsic value within a wilderness. In addition, they are critically important to the entire ecosystem by providing food and habitat to animals, preventing soil erosion, and contributing to soil health, and maintaining healthy local environmental conditions and biodiversity.

Index of Priority Invasive Plant Species

Measure Baseline Data Value: 231.2 (1995)

Current Data Value: 336.2 (2015)

Definitions:

- ***Invasive species***—a nonnative organism whose introduction causes or is likely to cause economic or environmental harm, or harm to human, animal, or plant health (Executive Order #13751, 2016).

Background and Context:

Nonnative plants are capable of altering ecosystems and threaten biodiversity by outcompeting native plant species. Without the natural competitors or predators that would be present in their native ranges, invasive plant species can proliferate in landscapes where they are introduced free from the processes that evolved to regulate the growth of native vegetation. Invasive species can affect native vegetative composition which, in turn, impacts wildlife habitat, with the potential to cause cascading impacts through the ecosystem. Plant and animal biodiversity richness, as well as fire regimes are in danger of alteration by nonnative plants.

Nonnative plant species are a threat to the Natural Quality in the MSD Wilderness, and pose a significant threat to the proposed wilderness areas in the East Everglades addition. NPS botanists identified approximately 270 nonnative plant species at various infestation levels currently occupying areas in Everglades National Park. While many of these nonnative species pose lesser impacts to the Everglades biotic community, some plant species have already substantially altered the wilderness landscape and habitats. Of the 270 nonnative plants identified in the park, four nonnative plant species including *Casuarina equisetifoli*, *Lygodium microphyllum*, *Melaleuca quinquenerviaI*, and *Schinus terebinthifolius* have been identified as a priority for Everglades National Park to eradicate (Table 8). These four nonnative species can be effectively and efficiently monitored over time. This list of four species is among another short list of 12 to 15 important and potentially threatening nonnative species; however, those additional species cannot be feasibly monitored at this time. The four priority species were introduced by humans, are the most pervasive, and pose the biggest threat to the Natural Quality.

Table 8. Priority Invasive Plant Species

Species Name	Description
Australian Pine *Casuarina equisetifolia*	Australian pine is native to Australia, Southeast Asia, India, Bangladesh, and the Pacific Islands and was introduced to tropical areas as an ornamental species, soil stabilizer, wind breaker around developments, and for reforestation purposes. The establishment of Australian pine can lead to beach erosion and interference with endangered sea turtle and crocodile nesting (FLEPPC 2013). Australian pine is a fast-growing tree that currently occupies approximately 1,306 gross acres (528 hectares) in the park. Current treatments include chemical and mechanical treatment methods. The desired condition of Australian pine in the park is less than 1% canopy cover per km² in the areas now or historically containing these species.
Old World Climbing Fern *Lygodium microphyllum*	Old world climbing fern is native to wet tropical and subtropical regions of Asia, Africa, and Australia and was introduced as an ornamental. Old world climbing fern is an aggressive invader growing over existing vegetation and smothers whole plant communities making it difficult for other plants to grow through its thick mats (FLEPPC 2006). Old world climbing fern invades freshwater and moist habitats in Florida and currently occupies approximately 9,945 gross acres (4,024 hectares) in the park. Current treatments include chemical, mechanical, and biological control treatment methods. The desired condition of old world climbing fern is less than 5% cover per km² in areas currently containing these species.
Melaleuca *Melaleuca quinquenervia*	Melaleuca is native to Australia and was introduced to Florida through several occasions in the early 1990s as an ornamental tree and commercial wood source. Mature melaleuca trees form dense monocultures that can dramatically reduce system diversity in wet prairie/marsh areas (FLEPPC 1999). Melaleuca rapidly expanded in Florida and currently occupies approximately 5,452 gross acres (2,206 hectares) in the park. Current treatments include chemical, mechanical, and biological control treatment methods. The desired condition of Melaleuca in the park is less than 1% canopy cover per km² in the areas now or historically containing these species.
Brazilian Pepper *Schinus terebinthifolius*	Brazilian pepper is native to Brazil, Argentina, and Paraguay and was introduced to the United States as an ornamental. Brazilian pepper is a pioneer of disturbed sites, successfully champions many native plant communities, and poses a threat to species diversity in Florida (FLEPPC 1997). Brazilian pepper is an aggressive colonizer in Florida and currently occupies approximately 41,707 gross acres (16,878 hectares) in the park. Current treatments include chemical and mechanical treatments. The desired condition of Brazilian pepper in the park is less than 5% cover per km² in areas currently containing these species.

Measure Description and Collection Protocol:

The data value is the total of the abundance index sums for each of the priority species identified below. The abundance index sum for each priority species is calculated by determining the number of 4 km x 4 km plots in which the species is detected in systematic reconnaissance flights, weighting each plot for the relative abundance of that species within the plot (Figure 16, Figure 17, Figure 18, Figure 19), and then totaling the weighted values (Table 9). The Exotic Vegetation Program Manager and Wilderness Coordinator have developed a map that shows which plots to exclude in the index because they include no wilderness. The data value for the measure should be determined by the Exotic Vegetation Program Manager, using data acquired from the South Florida/Caribbean Inventory and Monitoring Network. Consult with the park Botanist and/or Exotic Vegetation Program Manager to obtain an updated list of priority species to determine if inclusion in this measure is needed. A decrease in the number of priority species acreage coverage contributes to an upward trend for this indicator and benefits the Natural Quality.

Table 9. Abundance of priority invasive plant species in 1995 and 2015

Species	Abundance in 1995	Abundance in 2015
Australian Pine (Casuarina equisetifolia)	36.8	2
Old World Climbing Fern (Lygodium microphyllum)	0*	52.5
Melaleuca (Melaleuca quinquenervia)	39.2	9.9
Brazilian Pepper (Schinus terebinthifolius)	155.2	271.8
Total abundance for all species	194.4	336.2

**Lygodium microphyllum* was first detected in the park in 1999.

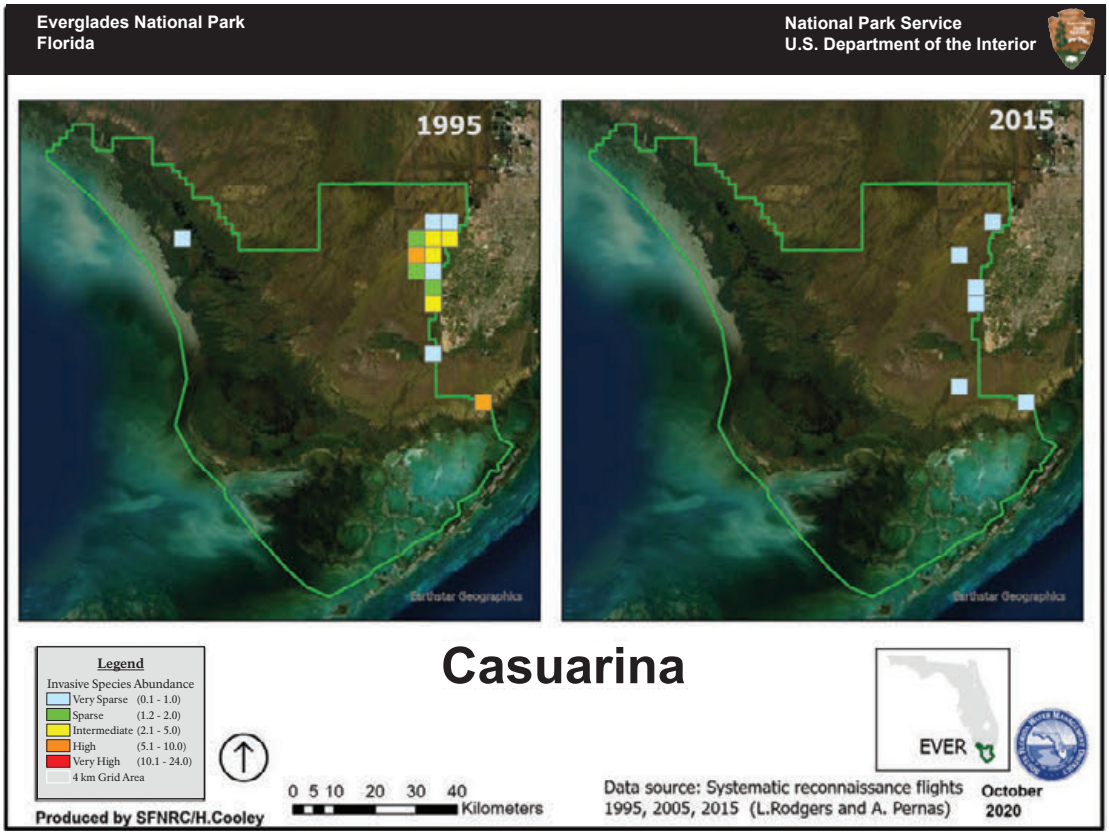

Figure 16. Change in abundance of Casuarina equisetifolia from 1995 to 2015.

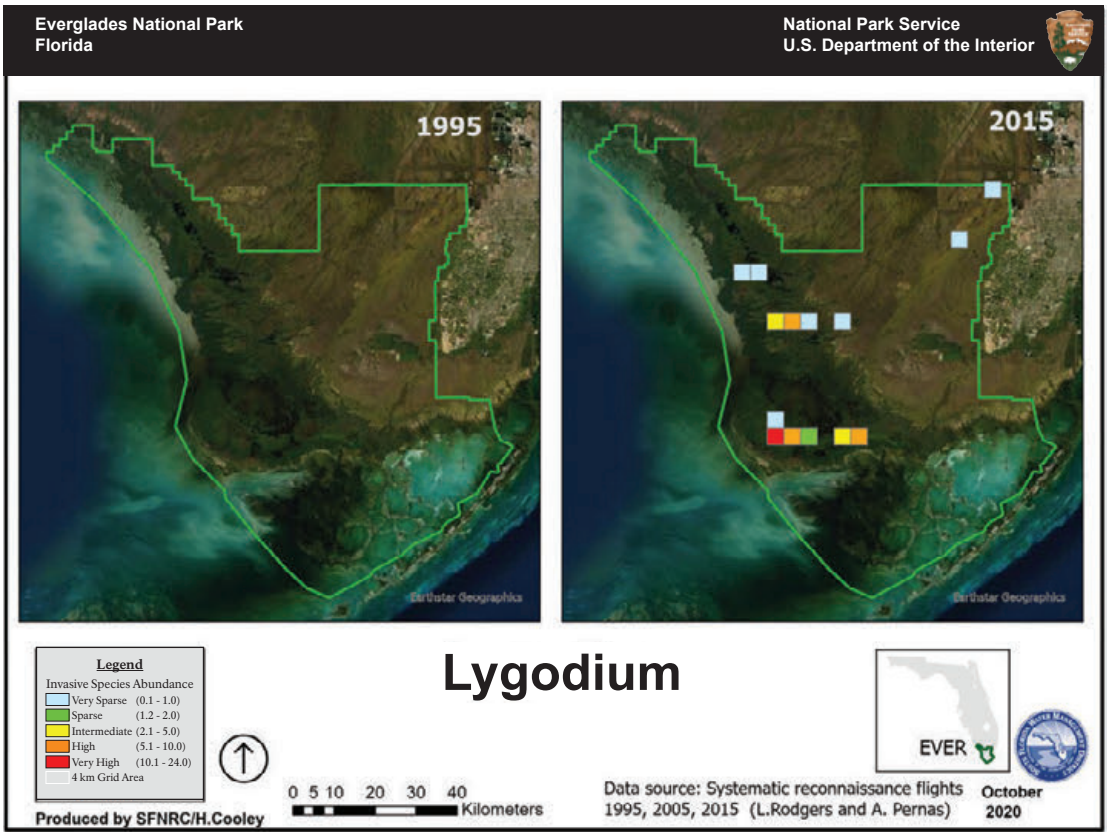

Figure 17. Change in abundance of Lygodium microphyllum from 1995 to 2015.

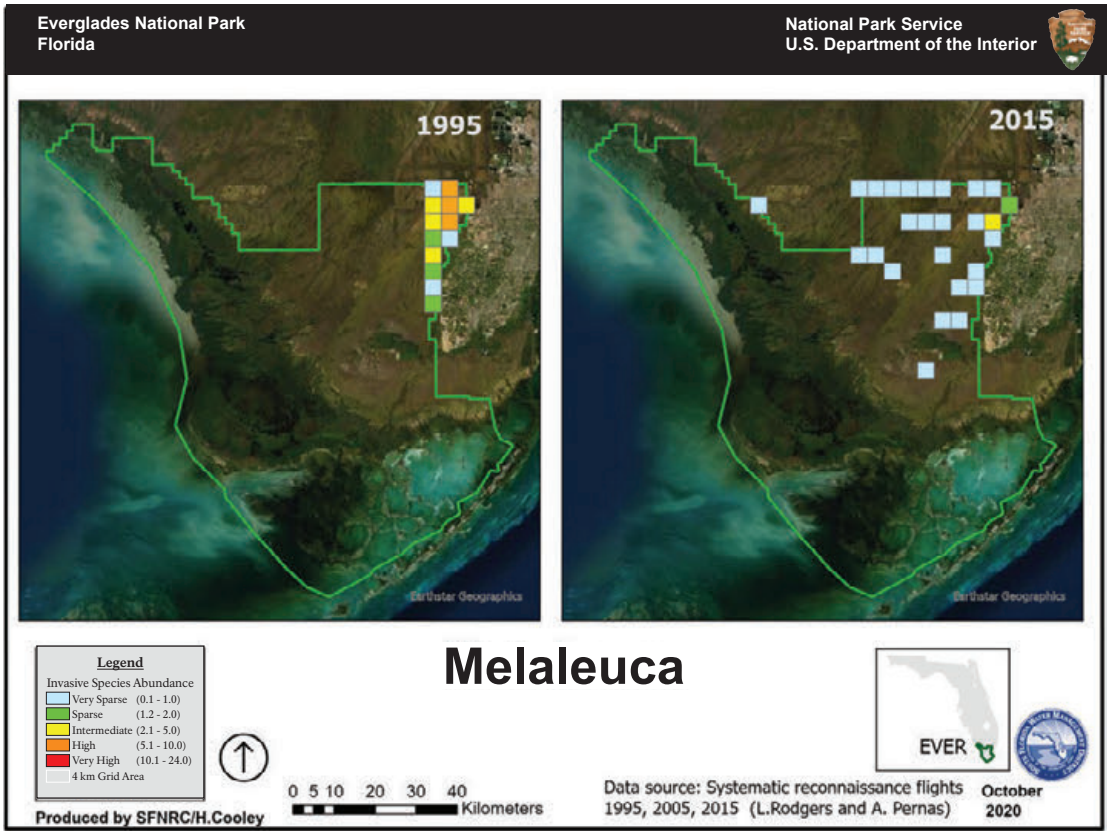

Figure 18. Change in abundance of Melaleuca quinquenervia from 1995 to 2015.

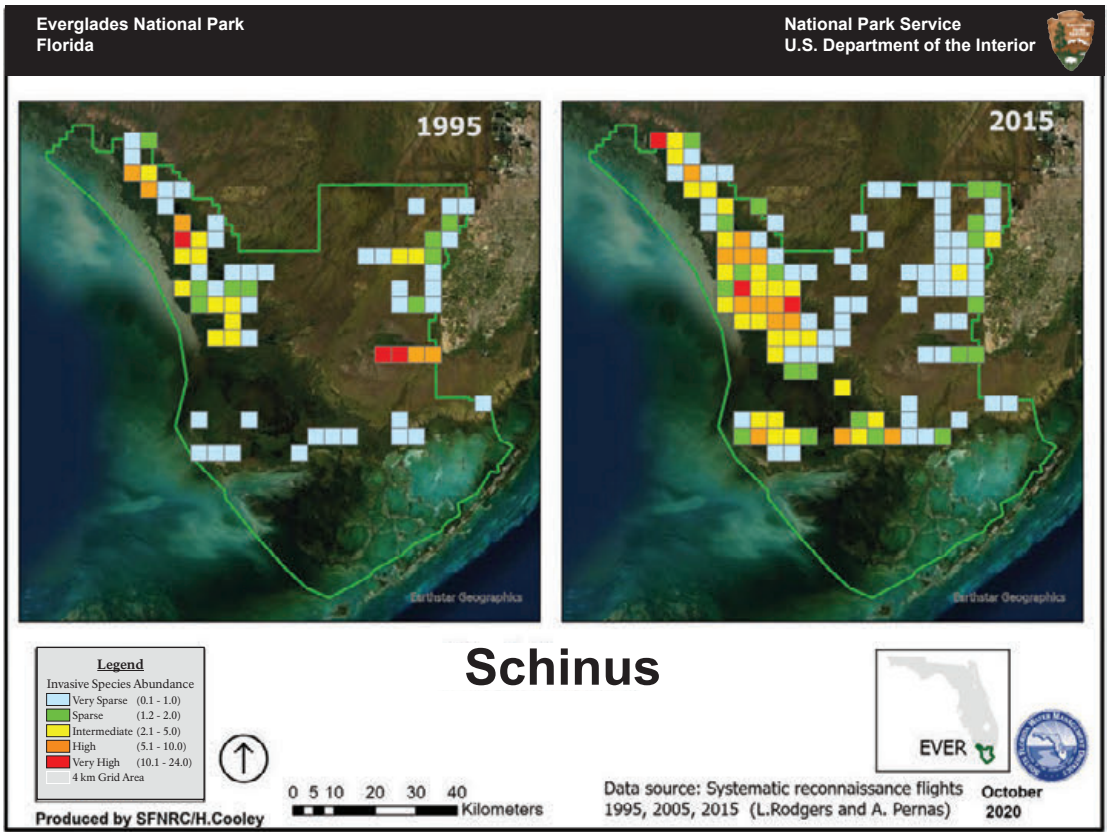

Figure 19. Change in abundance of Schinus terebinthifolius from 1995 to 2015.

Data Source:

- Rodgers, LeRoy, Tony Pernas, Jed Redwine, Brooke Shamblin, and Shea Bruscia. "Multiscale Invasive Plant Monitoring: Experiences from the Greater Everglades Restoration Area." Weed Science Society of America, 2014.
- Botanist, Invasive Species Program, Everglades and Dry Tortugas National Parks.

Data Adequacy:

Medium—Data quantity is partial and data quality is medium because the priority species were detected from an aerial survey with the best available technology. However, high accuracy of the area of priority species is difficult and ground-truthing is needed.

Frequency:

Data are compiled and analyzed every five years.

Meaningful Change:

The threshold for meaningful change is a 5% change in the total number of acres occupied by priority nonnative plant species. Once there are five measure values, the threshold for meaningful change will switch to regression analysis using a 90% confidence level (p-value <0.1). A decrease in the number beyond the threshold for meaningful change results in an improving trend in this measure.

Total Length of Propeller Scarring of Seagrass in Florida Bay

Measure Baseline Data Value: 624,457.1 meters (2011)

Current Data Value: 338,023.4 meters (2016)

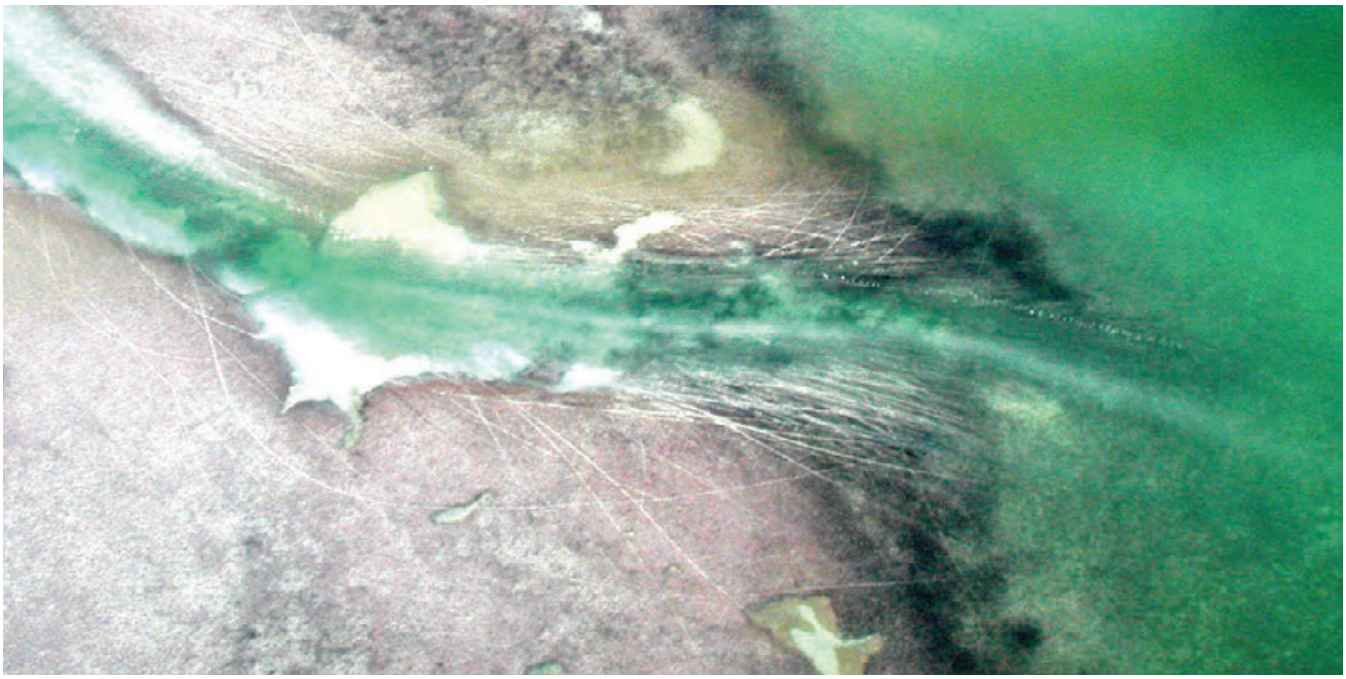

Figure 19. Seagrass scarring near Bob Allen Keys.

Definitions:

- No definitions provided.

Background and Context:

Seagrasses are submerged flowering plants found in shallow, marine waters. Seagrasses play an important role in these benthic environments as they provide food, habitat, and nursery areas, stabilize the sea bottom, and maintain water quality contributing to the overall productivity of the marine environment. Seagrasses are also an important indicator of oceanic ecosystem health (FWC n.d.b.).

One-third of the MSD Wilderness contains marine waters of which a large amount of seagrass is present contributing substantially to the Natural Quality of wilderness. The marine waters in the MSD have a unique designation called 'submerged marine land wilderness.' Under this designation, only the land underneath the water is fully designated wilderness while the remaining upper water column is not. This designation was designed to allow for continued use of motorboats in the marine areas as it was heavily embedded in the South Florida culture. However, these submerged marine land wilderness areas are very shallow with an average of less than 3 feet of water depth, creating a potential conflict between motorboat use and wilderness preservation.

Travel by motorboat is very popular among park visitors as the MSD submerged marine land wilderness is connected to open waters neighboring popular tourist destinations such as Key Largo and Key West, and the shallow waters offer prized fishing and recreation opportunities (NPS 2008). Navigating in and around the submerged marine land wilderness of Florida Bay can be challenging. Additionally, visitors have varying levels of skill and local marine knowledge. This combination of shallow waters and motorboat traffic create increased levels of seagrass propeller scarring (Figure 20). This is a major issue in the MSD Wilderness, particularly in Florida Bay. In 2011, ~388 miles of propeller scarring were recorded in three small representative areas of Florida Bay (~18,000 ac). These three areas represent ~3.7% of the overall acreage of Florida Bay (~484,000 ac) (Atkins 2017).

Seagrass scarring has heavy implications to the Natural Quality of wilderness character. Although seagrass scarring is only addressed in the Natural Quality, it can also have significant implications for the Solitude or Primitive and Unconfined Recreation Quality.

Measure Description and Collection Protocol:

The data value is the sum total length of seagrass scars within three representative zones in Florida Bay: (1) the Snake Bight Pole/Troll Zone (PTZ), (2) Reference Area 1 located just south of the Snake Bight PTZ, and (3) Reference Area 2 located in southern Florida Bay (Figure 21). Within the PTZ, motorboat use is restricted to push pole and trolling motors only whereas no such restrictions exist in the reference areas. Should this measure remain the same, the data should be gathered from future seagrass monitoring efforts using similar methodology as the 2011 aerial survey. Consult with park marine biologists for the most recent seagrass scar studies. A decrease in the sum total length of seagrass scars in Florida Bay results in an upward trend in this measure and benefits the Natural Quality.

This measure will undergo a change in the near future. The park recognizes the need to survey all of Florida Bay and park staff are currently working on assessing seagrass scarring, as well as evaluating the most appropriate methods by which scars could be identified and analyzed in the future. Once comprehensive data on seagrass scarring in Florida Bay becomes available, this measure will be updated. Regardless of methodology, this measure intends to capture human impact and thus propeller scarring of seagrass and must *quantify* seagrass scarring.

Data Source:

- Atkins. (2017). Snake Bight Pole Troll Zone: Revegetation Monitoring and Analysis. Final Report. Everglades National Park. Contract No. P11PC21000, Task Order No. P15PD03383.

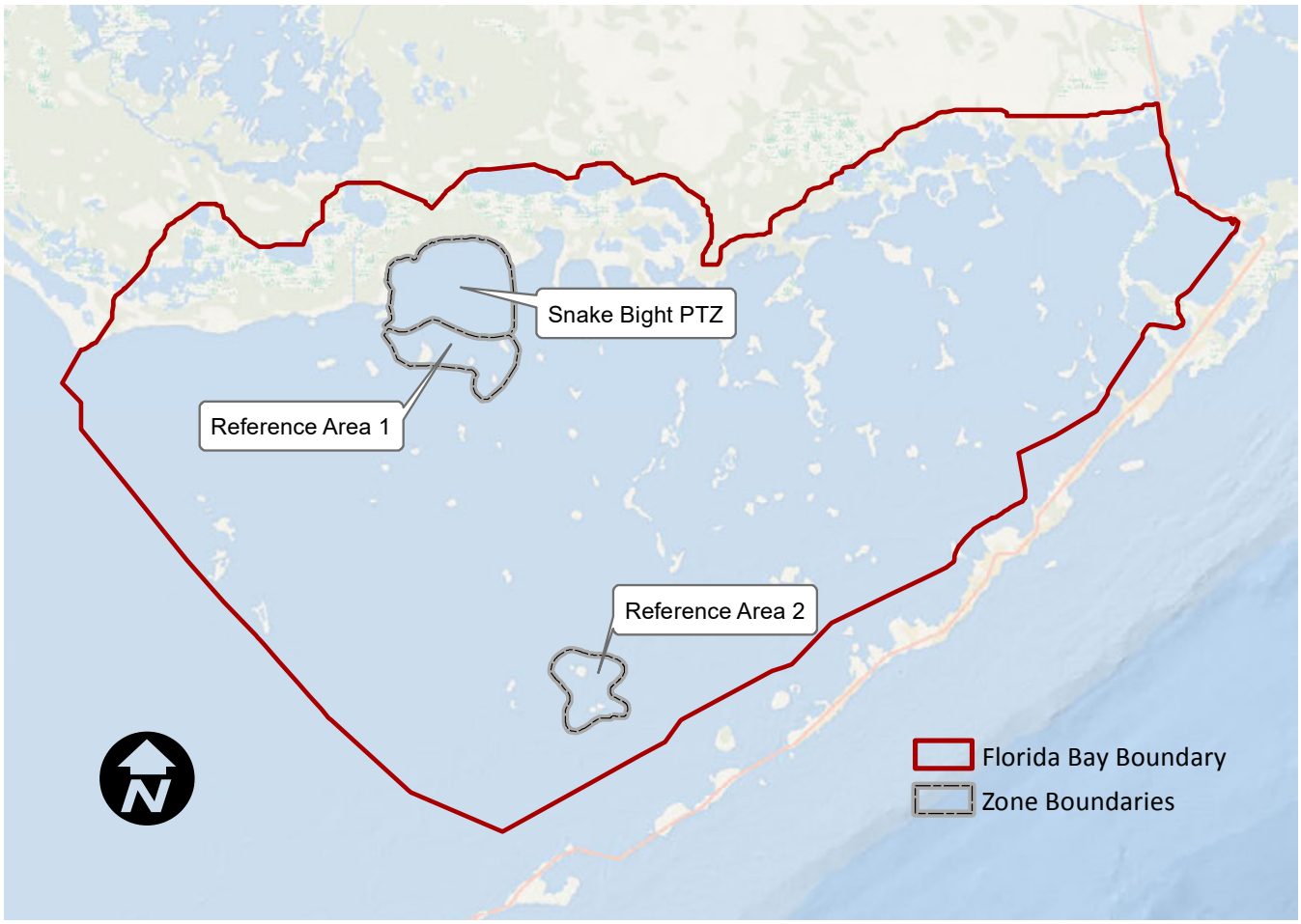

Figure 20. Areas in Florida Bay surveyed for seagrass scarring.

Data Adequacy:

Low—Data quantity is partial, and the data quality is poor because the field validation rate is low and inconsistent leaving uncertainty as to how many scars are actually present (Figure 22; Table 10).

Frequency:

Data are compiled and analyzed every five years. There is currently no regularly scheduled assessment of seagrass scarring in the MSD Wilderness, however regular monitoring efforts are intended to occur in the future.

Meaningful Change:

The threshold for meaningful change is a 5% change in the total length of scars. Once there are five measure values, the threshold for meaningful change will switch to regression analysis using a 90% confidence level (p-value <0.1). A decrease in the number beyond the threshold for meaningful change results in an improving trend in this measure.

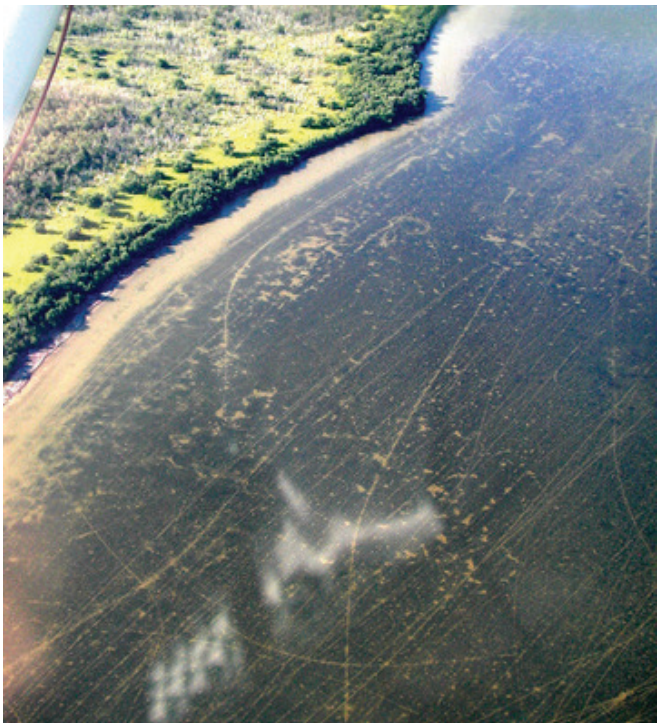

Figure 21. Propeller scars off Garfield Bight.

Table 10. Propeller Scarring of Seagrass in Florida Bay

Survey Area	Area (acres)	Total Number of Scars 2011	Total Number of Scars 2016	Summed Length of Scars (meters) 2011	Summed Length of Scars (meters) 2016	Percent Change in Length of Scars
Snake Bight PTZ	9,400	3,073	1,765	347,302.6	89,479.0	-74.2%
Reference Area 1	4,900	1,629	2,270	204,428.3	184,235.9	-9.9%
Reference Area 2	3,700	1,295	1,567	64,207.9	64,308.4	+0.2%
Multiple Areas*	N/A	43	–	8,518.3	–	–
All Areas	All Areas	6,040	5,602	624,457.1	338,023.4	-45.9%

*Those scars that traversed multiple zones in 2011 are included in the "Multiple Areas" row.

NPS Photo, P. Palma

NATURAL QUALITY

Animals

This indicator focuses on threats to indigenous animal species and communities. Indigenous animal species (also referred to as native animal species) and animal communities are an essential biological component of natural wilderness ecosystems. Indigenous animal species and communities are those that evolved in the area and therefore have intrinsic value within a wilderness. Additionally, they are critically important to the entire ecosystem by providing food and habitat to other animals, digesting plant material and thereby making nutrients available in the soil for plants to use, scavenging carcasses of dead animals, and contributing to a wilderness ecosystem in many other ways.

Presence of Nonnative Fishes

Measure Baseline Data Value: 49.3333 (2006)

Current Data Value: 54.3333 (2017)

Definitions:

- No definitions provided.

Background and Context:

Nonnative animal species can impact and alter the environment in a number of ways including preying on native species, out competing native species for food and resources, aiding in the spread of disease, and preventing the reproduction of native species (NWF n.d.). With the presence of globalization and ease of global transportation, the spread of nonnative animal species as a result of human influence are becoming a more common threat. The human caused introduction of nonnative animal species impacts the Natural Quality of wilderness character.

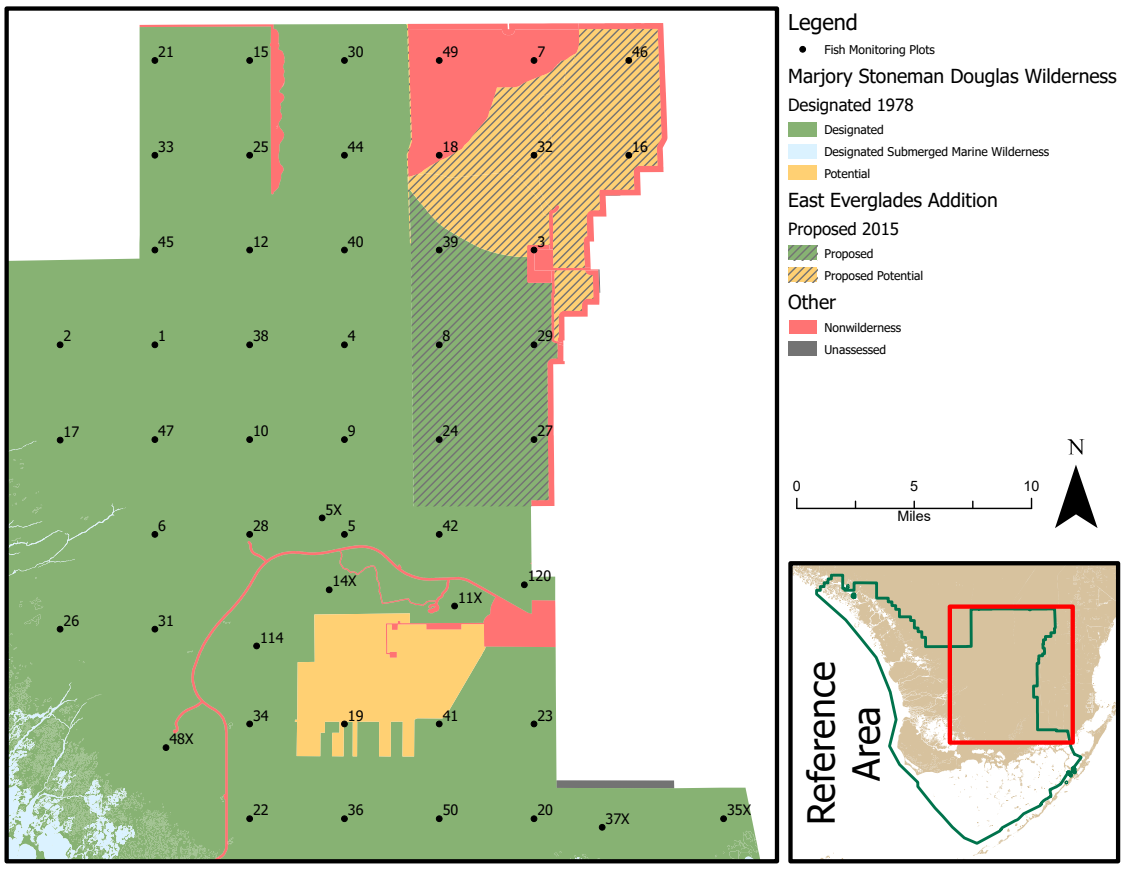

Figure 22. Map showing location of fish plots.

The invasion of exotic fishes and aquatic invertebrates continues to be a major challenge facing natural resource managers in South Florida, including within the MSD Wilderness and other lands managed as wilderness at Everglades National Park. Crisscrossed by large and small drainage canals, the landscape of present-day South Florida contains deep-water habitats that were uncommon prior to development. When released by pet owners or escaped from culture facilities, exotic fishes find refuge in deep water canals from the seasonal drying and cool winter temperatures that allow species of tropical origin, vulnerable to cold temperatures, to persist. As of 2012, 17 nonnative fishes have been found in the park, and 14 of these appear to have established reproductive populations. These exotic species represent a significant addition to the naturally species-poor native fish assemblage found in the freshwaters of the park. Periodic increases in the number of new exotic species observed appear to correspond with changes in connectivity of park marshes with canals resulting from modifications in the water management system. Preventing future introductions may be the most effective means to manage exotic fishes because effective control or elimination of exotic fishes is difficult and may be impractical within the extensive wetlands of the Everglades (Loftus 1988).

Measure Description and Collection Protocol:

The data value is the aggregate number of nonnative fish species present at 46 fixed plots established within the MSD Wilderness and other lands managed as wilderness at Everglades National Park, represented as a three-year moving average. Data is acquired from minnow traps (n=6) set at these fixed locations. The full dataset includes 50 sites, 4 of which are in locations not managed as wilderness (Figure 23). These sites—3, 7, 18, and 49—must be removed prior to analysis as data must be limited to only the 46 sites managed as wilderness. Once isolated to the appropriate sites, total the number of nonnative fish species captured per site for each year. This is the number of different species detected, not the number of individuals of those species. The number of nonindigenous species for each

site is then summed and used to calculate a three-year moving average (Figure 24). That average is the data value. A decrease in the aggregate number of nonnative fish species present contributes to an upward trend for this measure and benefits the Natural Quality.

Data Source:

- Fisheries Biologist, Everglades National Park

Data Adequacy:

High—Data quantity is complete and data quality is high because this is a long-term dataset with established protocols.

Frequency:

Data are compiled and analyzed annually after each sampling season.

Meaningful Change:

The threshold for meaningful change is a 5% change in the three-year rolling average for the aggregate number of nonnative fish species present. Park staff chose a three-year rolling average to account for potential annual variability in the data set while still being able to detect subtle changes over time, which may be unnoticeable by averaging over a longer timeframe. Once there are five measure values, the threshold for meaningful change will switch to regression analysis using a 90% confidence level (p-value <0.1). A decrease in the three-year rolling average beyond the threshold for meaningful change results in an improving trend in this measure.

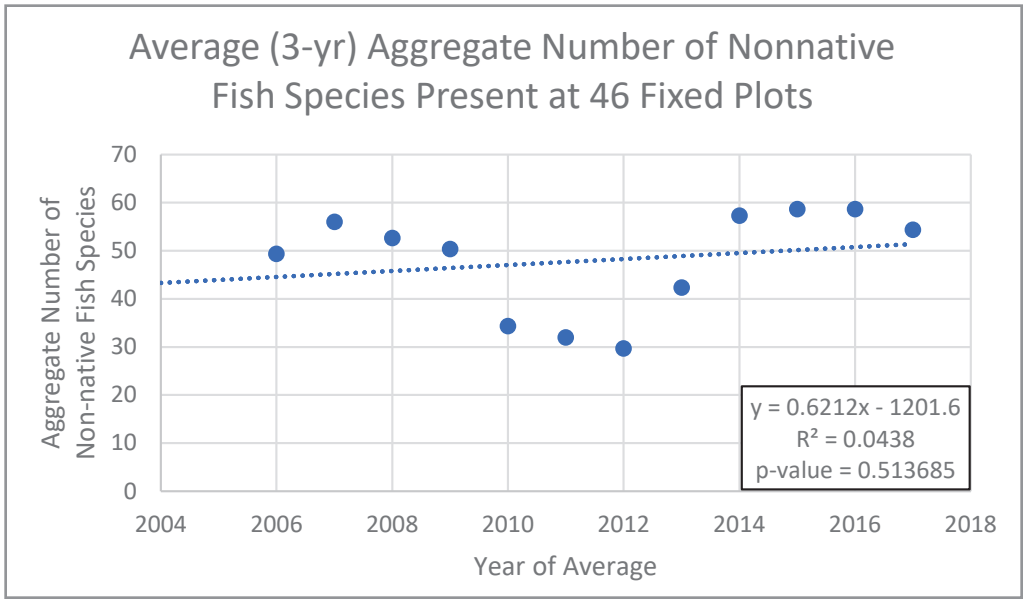

Figure 23. Three-year average of exotic fish species present at fixed sites, where Year of Average is the third year of the range. While the trendline indicates a possible declining trend, the p-value (0.514 > 0.1) indicates the trend is not statistically significant.

NPS Photo, G. Eseverri

NATURAL QUALITY

Air and water

This indicator focuses on threats to air and water quality and water quantity. Air and water are fundamental physical resources of wilderness ecosystems, and both are essential to maintain properly functioning natural systems inside wilderness. Both air and water resources are vulnerable to degradation by pollutants produced outside of wilderness as a result of human development and industrial activity.

The Clean Air Act of 1977 mandates special protections for values related to air quality in both Class I and Class II areas, many of which are also designated wildernesses. The presence of airborne pollutants in soil and water within wilderness can have direct adverse effects on sensitive plant and animal species and can directly impact essential ecosystem functions, such as nutrient cycling. Certain air pollutants also can reduce visibility. The effects of air pollution on plants, animals, soil, and water are important in all wildernesses, regardless of whether a wilderness is designated as Class I or Class II according to the Clean Air Act.

In addition to air pollutants, water quality and water flows also are vulnerable to the effects of physical manipulations inside and outside of wilderness. For example, agriculture activities upstream in the watershed can greatly affect the quality of water flowing into a wilderness. Likewise, dams and similar water control structures outside a wilderness can greatly impact the quantity of water that finds its way into a wilderness.

Haze on Mid-Range Days

Measure Baseline Data Value: 15.5 (2005)

Current Data Value: 13.7 (2017)

Figure 24. Example of the regional haze spectrum at Shark Valley in Everglades National Park. Photos from vista.cira.colostate.edu.

Definitions:

- No definitions provided.

Background and Context:

Fine particles in the atmosphere absorb and scatter light limiting visual range, shifting colors, and obscuring the details of distant objects (Malm 1999; National Academies of Science 1993). Reduced visibility causes increased reflective power that can affect local climate and photosynthetic activity. Increased reflective power can also impact wildlife species that depend on clear clean air for successful foraging. Fine particles that contribute to this regional haze include sulfates, nitrates, organics, elemental carbon, sea salt, and soil. The fine particles sulfate and nitrate exist predominately from anthropogenic sources and in many cases contribute predominately to visibility impairment (FS 2016). Sulfate forms from sulfur dioxide gas which is largely released from industrial sources. Nitrate forms from nitrogen oxide gas released from combustion activities (Malm 1999).

The US National Ambient Air Quality Standards were established by the US Environmental Protection Agency (USEPA) under the Clean Air Act. To aid in particle and visibility monitoring efforts, the Interagency Monitoring of Protected Visual Environments (IMPROVE) program focuses on non-urban area implemented in the United States and has stations in or near many National Park lands (NPS 1999). The National Park Service reported that visibility impairment caused by air pollution occurs in varying degrees at many park monitoring stations with significant impacts occurring in eastern parks. In the east, the average visual range is less than 20 miles or about one-fifth of the natural visual range of 100 miles. This visibility degradation is a consequence of broader regional-scale visibility impairment (National Academies of Science 1993) (Figure 25).

Classified as Class I area, Everglades National Park currently has the highest level of air quality protection present in United States law. Visibility in the MSD Wilderness and other lands managed as wilderness at Everglades National Park is important as it impacts visitor experience by determining how much of the river of grass a visitor can see on a given day, and visibility can impact other communities of life such as wildlife (NPS 2015a).

Measure Description and Collection Protocol:

This measure tracks haze on mid-range days expressed using haze index in deciviews. Mid-range days are sampled days with haze levels between the 40th and 60th percentiles of days sampled in a given year. The goal of wilderness character assessments is to evaluate trends in the natural environment from human-caused change. Mid-range days capture overall trends in human-caused contributions to haze by reducing the influence of episodic natural events such as wildfires and dust. These natural events often dominate the 20% haziest

days. Haze index condition assessments are based on estimated five-year average visibility on mid-range days minus the estimated natural visibility condition on mid-range days. The natural visibility conditions are those estimated to exist in a given area in the absence of human-caused visibility impairment. Estimated annual average natural condition on mid-range days equals 7.1 deciviews (dv) at Everglades National Park.

Data for this measure is collected from a monitoring station (EVER1) located behind the Bill Robertson Building. Using this data, the NPS Air Resources Division reports five-year visibility averages for Everglades National Park on an annual basis. To get data values:

- Go to https://www.nps.gov/subjects/air/park-conditions-trends.htm.
- Select *Everglades NP* from the Park dropdown.
- Select *Visibility* from the Parameter dropdown.
- In the Summary tab, click on *Rationale* +. Haze on mid-range days is reported in the *Condition* text. Record the first numeric for deciviews from the *Condition* text. For example, in the text below, the value for haze on mid-range days at Everglades for 2013–-2017 is 13.7 dv.

Condition: Visibility is fair at Everglades National Park based on NPS Air Resources Division benchmarks and the five-year average (2011–2015) estimated visibility (haze index) on mid-range days of 13.7 deciviews. This is 6.2 dv above the estimated natural condition of 7.1 dv.

Data Source:

- NPS Air Resources Division
- https://www.nps.gov/subjects/air/park-conditions-trends.htm
- https://www.nps.gov/subjects/air/analysis-methods.htm

Data Adequacy:

High—Data quantity is complete and data quality is high because Everglades National Park has an on-site visibility monitor, which on every third day collects 24-hour particulate samples that are used to calculate total visibility impairment as expressed by the haze index in deciviews (Figure 26).

Frequency:

Data are compiled and analyzed annually once new data becomes available. Note that due to quality assurance and data analysis procedures, there is usually a one-year lag time between the current year and the most recent available five-year average value.

Meaningful Change:

The threshold for meaningful change is any change of one deciview or more in either direction from the baseline data value. Once there are five measure values, the threshold for meaningful change will switch to regression analysis using a 90% confidence level (p-value <0.1). A decrease in the number beyond the threshold for meaningful change results in an improving trend in this measure.

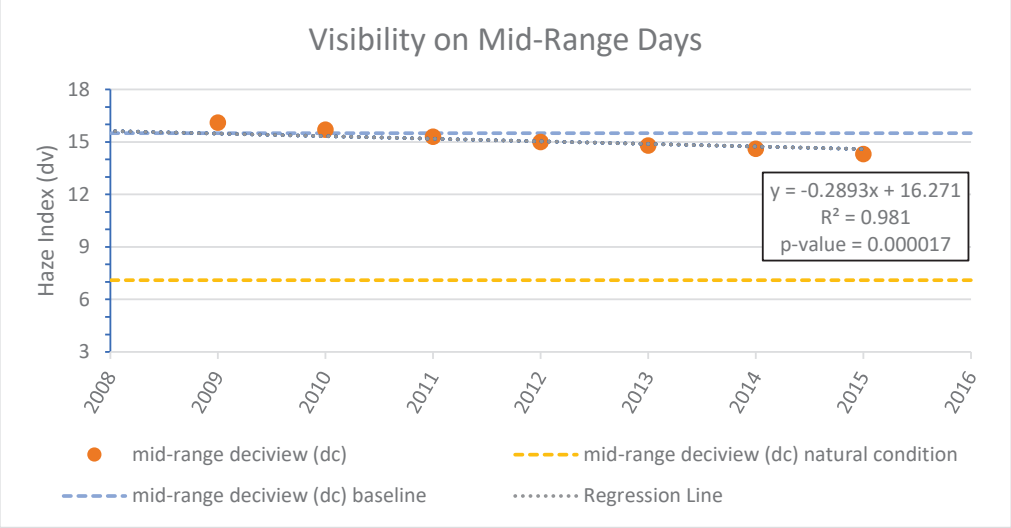

Figure 25. Visibility on mid-range days, including a regression line as well as the estimated natural condition in the absence of human-caused visibility impairment. Note: p-value is <0.1 indicating a significant trend.

Concentration of Inorganic Nitrogen in Wet Deposition

Measure Baseline Data Value: 2.3 kg/ha/yr (1986)

Current Data Value: 3.8 kg/ha/yr (2017)

Definitions:

- No definitions provided.

Background and Context:

Nitrogen is a major component of acidic deposition which causes physical and biological changes in freshwater lakes, rivers, ponds, and soils that can affect both aquatic and terrestrial ecosystems. The deposition of nitrogen can result in altered nutrient enrichment which may lead to changes in plant and animal diversity and shifts in ecosystem processes (NPS 2015a). The main sources of nitrogen oxide are motor vehicles, electric utilities, and industrial boilers. Similar to particulate haze pollution sources, levels of nitrogen in wet deposition are affected by a range of local and long-range emission sources (NADP n.d). Wet nitrogen deposition occurs when nitrogen is dissolved in cloud droplets and deposited during precipitation commonly known as acid rain.

The MSD Wilderness and other lands managed as wilderness at Everglades National Park consist of low nitrogen environments that are highly sensitive to nitrogen-enrichment effects (NPS 2015a; Sullivan et al. 2011a, Sullivan et al. 2011b). The shallow seagrass beds of the Gulf Coast and western Florida Bay are exposed to phosphorus from enriched Gulf waters and are more likely to respond sensitively to nitrogen enrichment compared to freshwater wetlands or Seagrasses in eastern Florida—where ambient phosphorus concentrations are very low. An influx of nitrogen may increase nonnative species establishment and survival as well as displace rare native species (NPS 2015a). The concentration of nitrogen in wet deposition is currently monitored at a state and regional level.

Measure Description and Collection Protocol:

This measure tracks atmospheric wet nitrogen deposition using the summed nitrogen portions of nitrate (NO3) and ammonium (NH4). Reporting units for wet deposition are kilograms per hectare per year (kg/ha/yr). While ecosystems respond to total (wet and dry) deposition, wet deposition is used as a surrogate for total deposition, because wet deposition is the most widely available source of measured nitrogen deposition data. Note that the NPS Air Resources Division will be modifying and improving the methodology for nitrogen deposition condition assessments in coming years by using total deposition estimates and established critical loads (NPS, Taylor, pers. comm., 2019). This will allow conditions to be set based on exceedance of a threshold of nitrogen deposition known to negatively impact an ecosystem component within the park. Once this occurs, this measure may need to be revised.

Figure 26. NADP monitoring station (FL11) located adjacent to the Dr. Bill Robertson, Jr. Building.

Data for this measure is collected from the National Atmospheric Deposition Program's (NADP) monitoring station (FL11) located behind the Bill Robertson Building (Figure 27).

Using this data, the NPS Air Resources Division reports five-year wet nitrogen deposition estimates for Everglades National Park on an annual basis. To get data values:

- Go to https://www.nps.gov/subjects/air/park-conditions-trends.htm.
- Select *Everglades NP* from the Parks dropdown.
- Select *Nitrogen Deposition* from the Parameter dropdown.

- In the Summary tab, click on *Rationale* +. Nitrogen deposition is reported in the *Condition* text. Record the number from the *Condition* text in kg/ha/yr. If a range is given, use the maximum of the range. For example, in the text below, the value for estimated wet nitrogen deposition at Everglades for 2013–-2017 is 3.8 kg/ha/yr. Record this number as the measure data value.

Condition: Wet nitrogen deposition levels create poor condition for ecosystem health at Everglades National Park. This is based on NPS Air Resources Division benchmarks and the five-year average (2013–2017) estimated 2.7 to 3.8 kilograms per hectare per year (kg/ha/yr) range of wet nitrogen deposition. To maintain the highest level of protection, the maximum of this range (3.8 kg/ha/yr) is used.

Data Source:

- NPS Air Resources Division
- https://www.nps.gov/subjects/air/park-conditions-trends.htm
- https://www.nps.gov/subjects/air/analysis-methods.htm

Data Adequacy:

High—Data quantity is complete and data quality is high because Everglades National Park has an on-site NADP/NTN monitoring station which is collected weekly and summarized annually (Figure 28).

Frequency:

Data are compiled and analyzed annually once new data becomes available. Note that due to quality assurance and data analysis procedures, there is usually a one-year lag time between the current year and the most recent available five-year average value.

Meaningful Change:

The threshold for meaningful change is any change of 0.5 kg/ha/yr or more in either direction from the baseline data value. Once there are five measure values, the threshold for meaningful change will switch to regression analysis using a 90% confidence level (p-value <0.1). A decrease in the number beyond the threshold for meaningful change results in an improving trend in this measure.

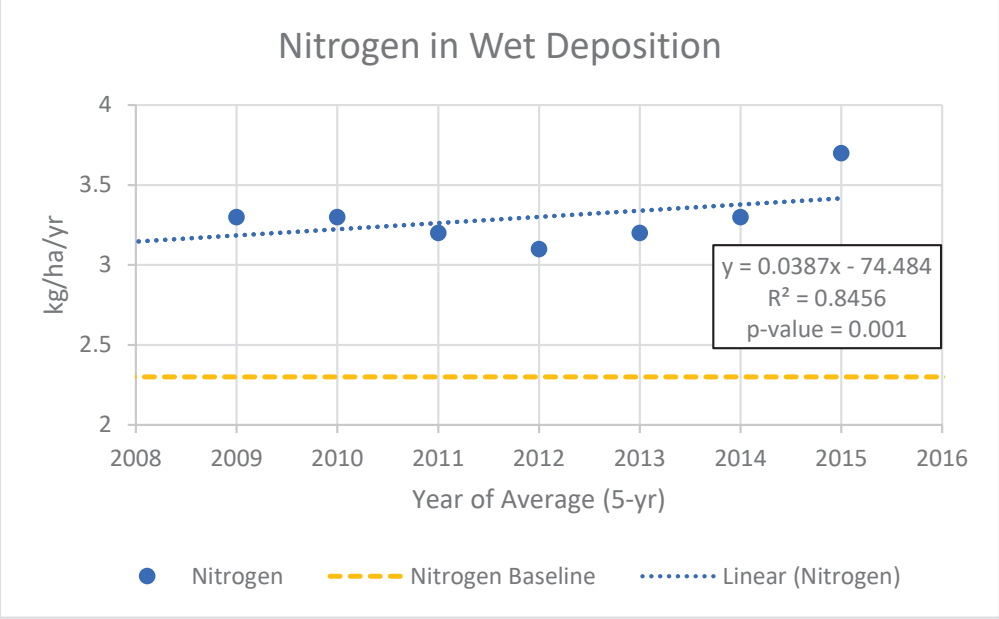

Figure 27. Wet nitrogen deposition estimates, including a regression line as well as the estimated natural condition in the absence of human-caused change. Note: p-value is <0.1 indicating a significant trend.

Concentration of Sulfur in Wet Deposition

Measure Baseline Data Value: 3.4 kg/ha/yr (1986)

Current Data Value: 3.1 kg/ha/yr (2017)

Definitions:

- No definitions provided.

Background and Context:

Sulfur is a major component of acidic deposition which causes chemical changes in freshwater lakes, streams, ponds, and soils that affect aquatic and terrestrial plants and animals (NPS 2015c). A decrease in the concentration of sulfur in wet deposition indicates a decrease in the threat of atmospheric pollutants to the wilderness. The largest source of sulfur dioxide in the atmosphere is the burning of fossil fuels by power plants and industrial facilities. Small sources of sulfur dioxide emissions include volcanoes and vehicular transportation (USEPA 2016). Sulfur also has an essential role in the methylation of mercury, which leads to toxic accumulation of mercury in fish and wildlife (NPS 2015a).

The MSD Wilderness and other lands managed as wilderness in Everglades National Park receive high levels of sulfur deposition, however the ecosystem in this wilderness is not acidification-sensitive and has low sensitivity to acidification effects relative to other parks (NPS 2015a; Sullivan et al. 2011a, Sullivan et al. 2011b). The main sources of sulfur in surface waters in the park are runoff from northern Everglades agriculture and emissions from coal-burning power plants (NPS 2015a).

Measure Description and Collection Protocol:

This measure tracks atmospheric wet sulfur deposition using the sulfur portion of sulfate (SO4). Reporting units for wet deposition are kilograms per hectare per year (kg/ha/yr). While ecosystems respond to total (wet and dry) deposition, wet deposition is used as a surrogate for total deposition, because wet deposition is the most widely available source of measured sulfur deposition data. As noted earlier, the NPS Air Resources Division will be modifying and improving the methodology for sulfur deposition condition assessments in coming years by using total deposition estimates and established critical loads. This will allow conditions to be set based on exceedance of a threshold of sulfur deposition known to negatively impact an ecosystem component within the park. Once this occurs, this measure may need to be revised.

Data for this measure is collected from the National Atmospheric Deposition Program's NADP monitoring station (FL11) located behind the Bill Robertson Building (see Figure 23). Using this data, the NPS Air Resources Division reports five-year wet nitrogen deposition estimates for Everglades National Park on an annual basis. To get data values:

- Go to https://www.nps.gov/subjects/air/park-conditions-trends.htm.
- Select *Everglades NP* from the Parks dropdown.
- Select *Sulfur Deposition* from the Parameter dropdown.
- In the Summary tab, click on *Rationale* +. Sulfur deposition is reported in the *Condition* text. Record the number from the *Condition* text in kg/ha/yr. If a range is given, record the maximum of the range. For example, in the text below, the value for estimated wet sulfur deposition at Everglades for 2013–2017 is 3.1 kg/ha/yr. Record this number as the measure data value.

Condition: Wet sulfur deposition levels create poor condition for ecosystem health at Everglades National Park. This is based on NPS Air Resources Division benchmarks and the five-year average (2013–2017) estimated 2.2 to 3.1 kilograms per hectare per year (kg/ha/yr) range of wet nitrogen deposition. To maintain the highest level of protection, the maximum of this range (3.1 kg/ha/yr) is used.

Data Source:

- NPS Air Resources Division
- https://www.nps.gov/subjects/air/park-conditions-trends.htm
- https://www.nps.gov/subjects/air/analysis-methods.htm

Data Adequacy:

High—Data quantity is complete and data quality is high because Everglades National Park has an on-site NADP/NTN monitoring station which is collected weekly and summarized annually (Figure 29).

Frequency:

Data are compiled and analyzed annually once new data becomes available. Note that due to quality assurance and data analysis procedures, there is usually a one-year lag time between the current year and the most recent available five-year average value.

Meaningful Change:

The threshold for meaningful change is any change of 0.5 kg/ha/yr or more in either direction from the baseline data value. Once there are five measure values, the threshold for meaningful change will switch to regression analysis using a 90% confidence level (p-value <0.1). A decrease in the number beyond the threshold for meaningful change results in an improving trend in this measure.

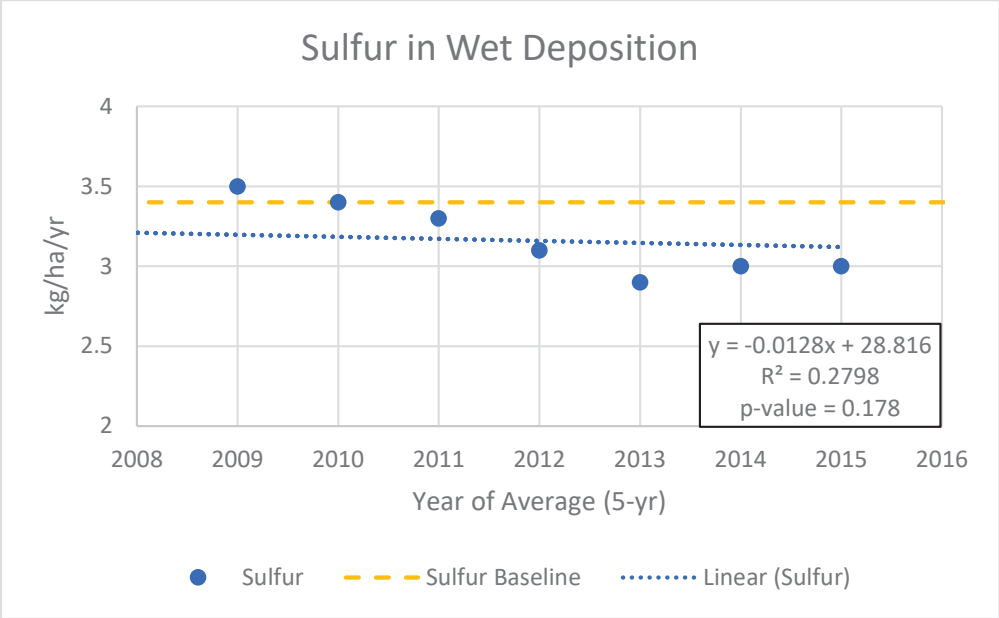

Figure 28. Wet sulfur deposition estimates, including a regression line as well as the estimated natural condition in the absence of human-caused change. Note: the p-value is >0.1 indicating the trend is not statistically significant.

NPS Photo, G. Gardner

NATURAL QUALITY

Ecological processes

This indicator focuses on threats to ecological processes that affect biotic and abiotic components of wilderness ecological systems. Ecological processes are the interactions among the biotic and abiotic components of ecosystems and include disturbance events (e.g., fire and windstorms, insect and pathogen outbreaks), predation, competition, decomposition, symbioses, and nutrient cycling. Ecological processes involve multiple components of wilderness ecosystems and are critical to all aspects of ecosystem composition, structure, and function, resulting in long-term and cascading effects on the natural community in wilderness. The integrity of ecological processes is crucial to maintaining the Natural Quality of wilderness character. Ecological processes are complex and difficult to quantify.

Index of Total Phosphorus Concentrations in Periphyton

Measure Baseline Data Value: 5.33333 (2007)

Current Data Value: 3.66667 (2016)

Definitions:

- No definitions provided.

Background and Context:

Phosphorus is an essential nutrient for plants and animals, playing a critical role in cell development. Unlike nitrogen and sulfur, the atmosphere does not play a significant role in the dynamics of phosphorus; rather phosphorus moves slowly through rocks, water, soil, sediments, and organisms (Science Learning Hub n.d.). Although phosphorus is a naturally occurring nutrient, phosphorus quantities in soil are generally small. Phosphorus plays an important role in aquatic systems as it may be a limiting nutrient. Phosphorus is introduced into water systems from agricultural fertilizer and urban runoff (USGS n.d.). When excessive phosphorus is present, it can speed up eutrophication —the process by which an entire body of water, or parts of it, becomes progressively enriched with minerals and/or nutrients. In plants, this can cause excessive growth, which, in turn, can change community composition and affect species higher in the food chain.

The MSD Wilderness and other lands managed as wilderness at Everglades National Park are excellent examples of low nutrient systems that are highly sensitive to increased phosphorus levels. Increased phosphorus levels are especially likely because the park is adjacent and downstream to large agricultural lands. Periphyton is an important feature of the Everglades ecosystem and contributes a large portion of net primary productivity. Periphyton responds to changes in environmental conditions at both small and large spatial scales in a matter of days to a few weeks making it a potential early ecological indicator of impacts upon the Natural Quality. Even small increases in surface water phosphorus concentrations can decrease periphyton biomass and shift the periphyton community structure, ultimately impacting higher trophic levels (Gaiser 2009).

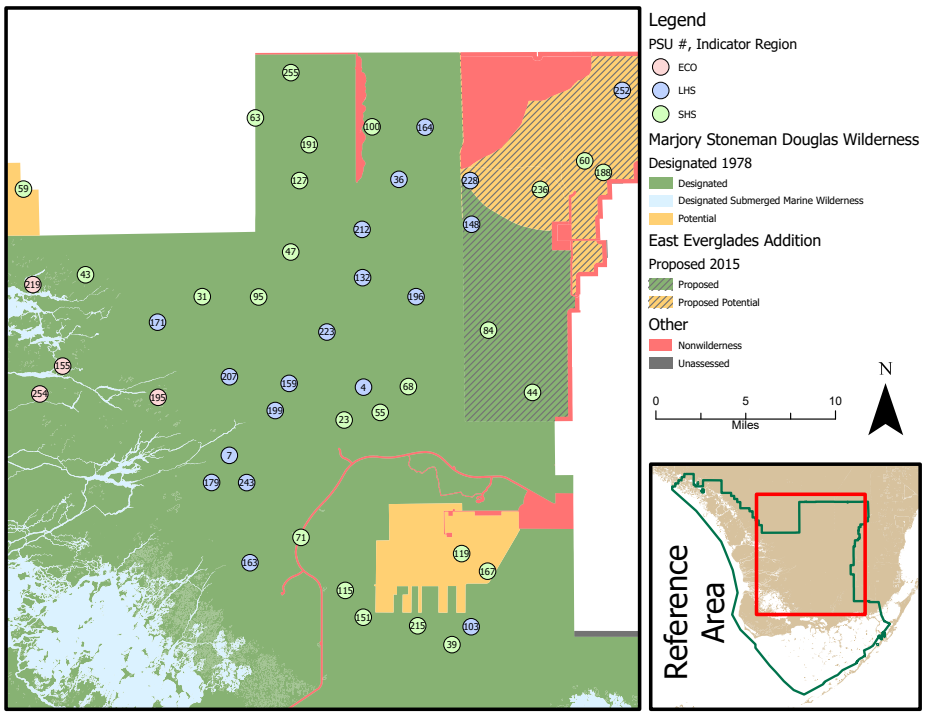

Figure 29. Map of PSUs with identifying number by indicator region (SHS = Short Hydroperiod Slough, LHS = Long Hydroperiod Slough, and ECO = Oligohaline Ecotone).

Measure Description and Collection Protocol:

The data value is the number of sites at which total phosphorus (TP, µg/g dw) content exceeded baseline expectations, weighted by severity, and represented as a three-year moving average. The protocol for this measure is derived from an indicator developed by Dr. Evelyn Gaiser at Florida International University for the purpose of offering a qualitative assessment of ecosystem response to potential changes in management activities at a time scale appropriate for active management. That indicator was based on three periphyton attributes: abundance, quality (i.e., nutrient content), and community composition (Gaiser 2009). This measure will focus on only one of those attributes—quality.

On an annual basis (September through November), Dr. Gaiser's lab collects triplicate periphyton samples from Principal Sampling Units (PSUs, 150 total) located throughout the Greater Everglades Region. Forty-eight (48) PSUs are located within wilderness managed by Everglades National Park (Figure 30).

Once analyzed, the resulting data from those 48 PSUs, TP in particular, will be obtained from Dr. Gaiser. The TP mean for each PSU will then be compared to baseline expectations or standards established for indicator regions within which each PSU has been appointed (Gaiser, Childers, et al. 2006), and assign a color code to each PSU based on the deviation from those standards. If the TP mean is within one standard deviation of the mean, it is designated green (natural), between one and two standard deviations is designated yellow (caution), and beyond two standard deviations is designated red (altered) (Gaiser 2009) (Figure 31). Each color code is then assigned a weight (Green = 0, Yellow = 1, and Red = 2), which is then summed per year. The yearly sums are used to calculate a three-year moving average. That average is the data value.

Standards for Indicator

Periphyton Indicator Region	MEAN	SD1	SD2
LHS	156	317	477
SHS	108	179	331
ECO	488	765	1043

Figure 30. Baseline expectations or standards for each indicator region (SHS = Short Hydroperiod Slough, LHS = Long Hydroperiod Slough, and ECO = Oligohaline Ecotone). These standards are used to assign color codes to TP concentration for each PSU.

Data Source:

Gaiser, Evelyn

2009 Periphyton as an indicator of restoration in the Florida Everglades. *Ecological Indicators*, 9(6), S37–S45.

Gaiser, Evelyn E., Daniel L. Childers, Ronald D. Jones, Jennifer H. Richards, Leonard J. Scinto, and Joel C. Trexler

2006 "Periphyton responses to eutrophication in the Florida Everglades: Cross-system patterns of structural and compositional change." *Limnology and Oceanography* 51 (1, part 2): 617630.

Truman, Harry S.

1947 "Dedication Ceremonies for Everglades National Park. " Everglades, Florida, December 6.

Data Adequacy:

High—Data quantity is complete and data quality is high because this is a long-term dataset that is also utilized for performance measures related to the Comprehensive Everglades Restoration Plan (CERP) as well as for reporting requirements pertaining to Everglades' status as a World Heritage Site.

Frequency:

Data are compiled and analyzed annually once new data becomes available from Dr. Evelyn Gaiser.

Meaningful Change:

The threshold for meaningful change is a 5% change in the three-year weighted average for total phosphorus standard exceedances. Park staff chose a three-year rolling average to account for potential annual variability in the data set while still being able to detect subtle changes over time which may be unnoticeable by averaging over a longer timeframe. Once there are five measure values, the threshold for meaningful change will switch to regression analysis using a 90% confidence level (p-value <0.1). A decrease in the three-year rolling average beyond the threshold for meaningful change results in an improving trend in this measure (Figure 32).

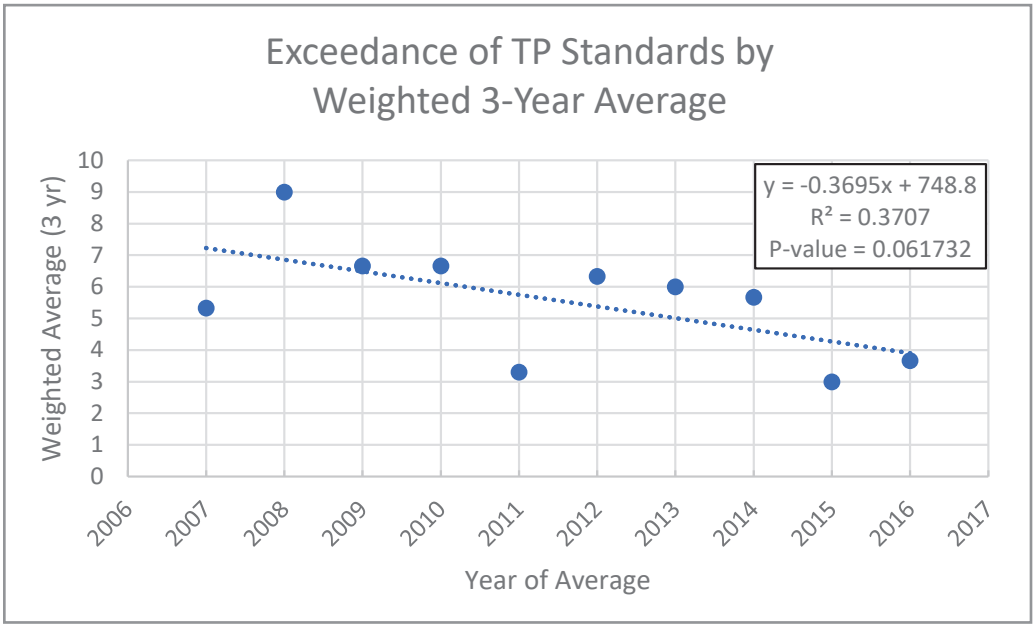

Figure 31. Three-year weighted average of TP standard exceedances, where Year of Average is the third year of the range. The downward trendline along with the low P-value (0.062 < 0.1) indicates a statistically significant improving trend for this measure.

Percentage of Acres Within the Maximum Expected Fire Return Interval

Measure Baseline Data Value: 23.65% (1978)

Current Data Value: 52.45% (2020)

Definitions:

- No definitions provided.

Background and Context:

Fire is an essential natural process in the Everglades and plays a key role in shaping ecosystems. It restores and maintains fire adapted vegetation communities including wet prairies and sawgrass marshes and plays a role in the restoration and protection of rare and unique ecosystems including the pine rocklands, tropical hardwood hammocks, and transverse glades. Fire prevents woody plant encroachment and unnatural vegetation succession, opens canopies, reduces competition, provides new food sources, and maintains the balance between fire adapted and fire sensitive ecosystems. In fire adapted ecosystems, a natural fire regime maintains habitat for plants and wildlife and maintains fuel loads which can lessen the likelihood that natural or human caused fires will spread into fire sensitive habitats.

The Everglades has a long history of fire. Historic fire regimes in the Everglades reflect natural as well as aboriginal influences (Schwadron 2010). Prior to drainage and development, fire would have spread across connected fire adapted landscapes. Development and urban expansion have fragmented natural areas across the historic Everglades. This habitat fragmentation has disrupted natural fire spread, reducing fire frequency and altering natural fire regimes. Lack of natural and historic fire spread and the need to suppress fires that threaten life and property can impact the fire regime.

Decreases in natural fire occurrence following development and habitat fragmentation and the need to suppress fires that may threaten life and property have and will continue to impact the natural fire regime within the MSD Wilderness and other lands managed as wilderness at Everglades National Park. As a result, it is expected that a combination of prescribed fire and management of naturally ignited fires will be required to maintain natural fire regimes. Fire, regardless of ignition source may serve to maintain the natural fire regime and natural vegetation communities; however, prescribed and naturally ignited fires are the most likely to benefit the landscape as unplanned human caused fires often occur when conditions are likely to produce more severe fire effects than the everglades vegetation communities generally experienced historically.

Fire regime is a description of an area's fire return interval combined with the severity of fire effects on the landscape. Evaluating fire regime as a whole can be complex, particularly evaluating and incorporating severity across a landscape. To simplify analysis for this measure, only the fire return interval is used to approximate anthropogenic impacts on the fire regime.

Measure Description and Collection Protocol:

This measure assesses the percentage of burnable acres within wilderness that have been burned within the maximum expected fire return interval. A fire return interval is the number of years between fires at a specific location or plant community. Fire return interval range is the span of years between the shortest and longest periods between fires in a vegetation type. Fire return intervals for community types in the park were chosen based on literature and decisions made by the Interdisciplinary Team while developing the Fire Management Plan (2015). Table 11 provides the fire return intervals for each fire adapted community type within the park. The maximum for each range is used to calculate this measure.

Table 11. Fire Return Intervals for Each Fire Adapted Community Type

Community Type—Fire Management Unit (FMU)	Fire Return Interval (Years)
Coastal Prairie—FMU 1	2–10
Saw Grass—FMU 2 / FMU 3 / FMU 4	3–12
Muhly Grass / Marl Prairie—FMU 2 / FMU 3 / FMU 4	3–12
Pine Rockland—FMU 3	3–7

Computation of this measure is a GIS exercise, and is best conducted by someone who is familiar and experienced with GIS analysis as well as the fire management program. The general process is as follows:

1. Create (or obtain) layer for all areas managed as wilderness, sans submerged wilderness (submerged lands can't burn) and the Hole-in-the-Donut (HID) Restoration Area (see Caveat below).
2. Create (or obtain) layer for burnable vegetation from the University of Georgia Vegetation Map layer using the following burnable veg selection key SQL query.

   "DOMINANTVE" = 'FP' OR "DOMINANTVE" = 'FC' OR "DOMINANTVE" = 'FSa' OR "DOMINANTVE" = 'FSc' OR "DOMINANTVE" = 'FSd' OR "DOMINANTVE" = 'FSc' OR "DOMINANTVE" = 'FSt' OR "DOMINANTVE" = 'FSx' OR "DOMINANTVE" = 'FSCpi' OR "DOMINANTVE" = 'SP' OR "DOMINANTVE" = 'SS' OR "DOMINANTVE" = 'SVPI' OR "DOMINANTVE" = 'SVx' OR "DOMINANTVE" = 'SVPIh' OR "DOMINANTVE" = 'SVPIc' OR "DOMINANTVE" = 'SVC' OR "DOMINANTVE" = 'SVCd' OR "DOMINANTVE" = 'SVCpi' OR "DOMINANTVE" = 'SVPM' OR "DOMINANTVE" = 'PG' OR "DOMINANTVE" = 'PGj' OR "DOMINANTVE" = 'SVPI' OR "DOMINANTVE" = 'PGc' OR "DOMINANTVE" = 'PGm' OR "DOMINANTVE" = 'PGs' OR "DOMINANTVE" = 'PGe' OR "DOMINANTVE" = 'PGp' OR "DOMINANTVE" = 'PGa' OR "DOMINANTVE" = 'PGw' OR "DOMINANTVE" = 'PGx' OR "DOMINANTVE" = 'PE' OR "DOMINANTVE" = 'PEa' OR "DOMINANTVE" = 'PEo' OR "DOMINANTVE" = 'PC' OR "DOMINANTVE" = 'PH' OR "DOMINANTVE" = 'PHg' OR "DOMINANTVE" = 'PPI' OR "DOMINANTVE" = 'SBs' OR "DOMINANTVE" = 'SBf' OR "DOMINANTVE" = 'SBm' OR "DOMINANTVE" = 'SBb' OR "DOMINANTVE" = 'SBc' OR "DOMINANTVE" = 'SB1' OR "DOMINANTVE" = 'SBt' OR "DOMINANTVE" = 'EM' OR "DOMINANTVE" = 'EC' OR "DOMINANTVE" = 'EO' OR "DOMINANTVE" = 'EA' OR "DOMINANTVE" = 'PGct' OR "DOMINANTVE" = 'PGh' OR "DOMINANTVE" = 'P'

3. Clip burnable vegetation for each combination of plant community type and maximum fire return interval to create independent feature layers.
4. Clip each of these layers to the layer created in step 1.
5. Calculate acreage for each layer created in step 4. This is the total number of acres that could potentially burn within each given area. Calculate the sum of these acres.
6. Identify the range of years to be included for each fire return interval for a given reporting year. For example, the MSD Wilderness was designated in 1978. To determine the range for each fire return interval for the baseline measurement, the maximum fire return interval was subtracted from that year plus 1 (i.e., 1978 - 7-year max FRI = 1971 + 1 = 1972). In this example, data used would be those collected in 1972, 1978, and all years in between. This same method would be used for calculating values for future years.
7. Using fire perimeter data, merge data for each range of dates calculated in step 6. A separate feature layer should be created for each maximum fire return interval.
8. Clip each layer created in step 4 with the corresponding layer created in step 7 (i.e., match the maximum fire return intervals for these layers).
9. Calculate acreage for each layer created in step 8. This is the total number of acres that actually burned within each given area. Calculate the sum of these acres.
10. Divide the sum acres calculated in step 9 by the sum acres calculated in step 5, then multiply by 100 to calculate the percentage of burnable acres that actually burned within each maximum fire return interval for all areas managed as wilderness. This percentage is the measure value.

Table 12 shows the measure value for the baseline year of 1978, while Table 13 shows the measure value for 2020. Figure 33 shows the areas of wilderness that are within the maximum fire return interval for 1978 and 2020.

Table 12. Percentage of Acres in Each Vegetation Community within the Maximum Fire Return Interval in 1978

FMU	Veg Community	Max FRI	Burnable Acres	Burned Acres	% Acres within Max FRI
1	Coastal Prairie	10 yr	90,228.15	9,147.25	10.14%
2	Grass/Prairie	12 yr	315,632.96	65,750.08	20.83%
3	Grass/Prairie	12 yr	22,769.31	16,723.17	73.45%
3	Pine Rockland	7 yr	14,910.11	13,270.27	89.00%
Sum	–	–	443,540.52	104,890.78	23.65%

Table 13. Percentage of Acres in Each Vegetation Community within the Maximum Fire Return Interval in 2020

FMU	Veg Community	Max FRI	Burnable Acres	Burned Acres	% Acres within Max FRI
1	Coastal Prairie	10 yr	90,228.15	78,111.67	86.57%
2	Grass/Prairie	12 yr	315,632.96	150,377.39	47.64%
3	Grass/Prairie	12 yr	22,769.31	13,573.28	59.61%
3	Pine Rockland	7 yr	14,910.11	13,756.69	92.26%
4	Grass/Prairie	12 yr	78,100.27	17,778.56	22.76%
Sum	–	–	521,640.78	273,597.59	52.45%

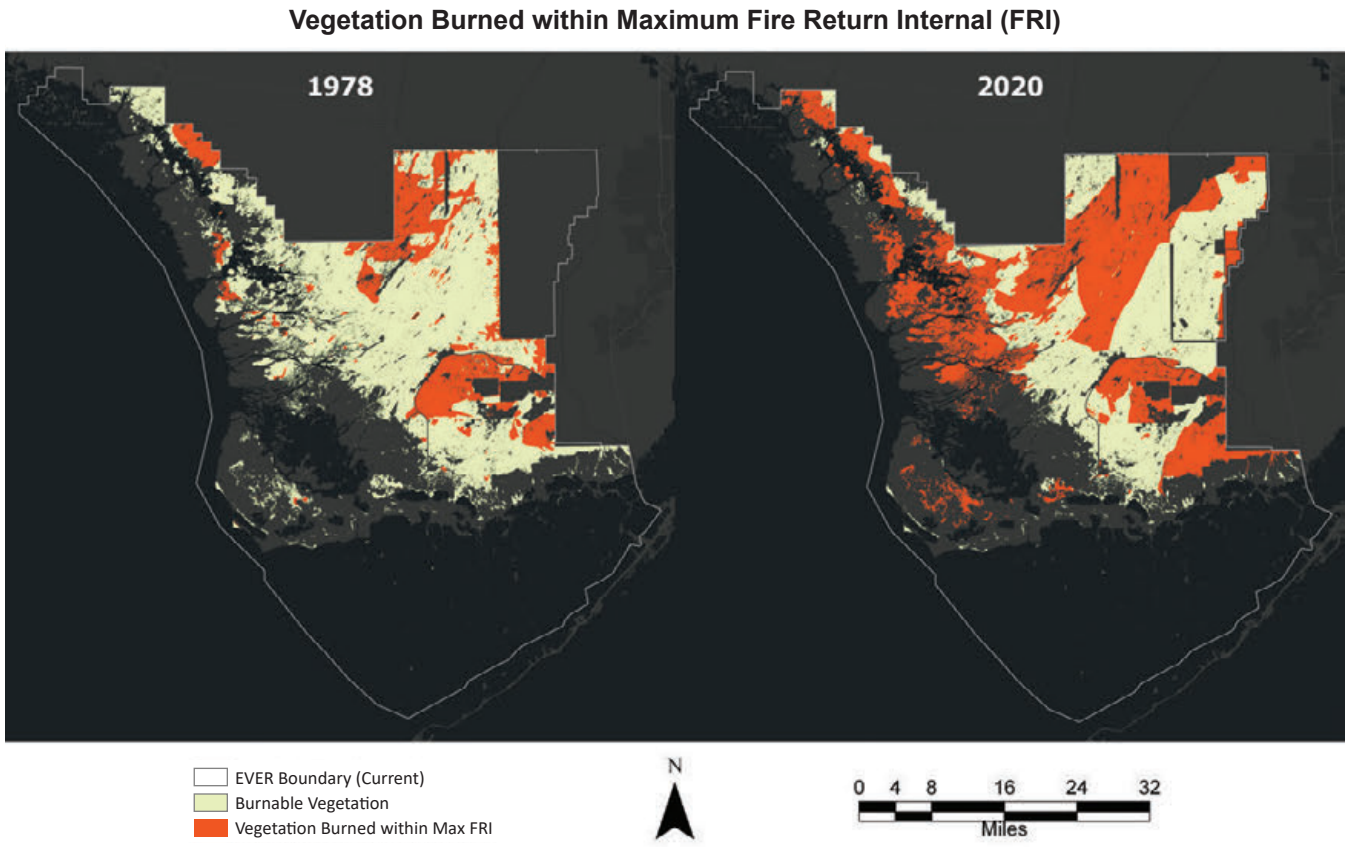

Figure 32. Areas burned within maximum fire return interval (burned vs. unburned) for baseline and current year.

The higher the percentage, the closer wilderness areas are to being within the expected fire return interval for burnable vegetation. This also means fire is allowed to serve its role on the natural landscape.

Caveats:

If a new vegetation layer becomes available in the future, park staff will need to decide which layer is most appropriate to use for the range of dates being calculated, as well as the appropriateness of recalculating prior measure values. Additionally, this may be true for fire perimeter shape files as technology improves and provides new ways to measure and map fire perimeters and burned areas. Furthermore, values should be calculated in relation to the wilderness boundaries as they were/are during the selected period of record. Total acreages change over time as lands within the park are evaluated for wilderness designation. For example, in 2015, the National Park Service proposed the designation of approximately 42,200 acres in the East Everglades Addition as wilderness and an additional 43,100 acres as potential wilderness.

Finally, the potential wilderness area known as the Hole-in-the-Donut (HID) was excluded from analysis at this time because the area has largely been covered by exotic vegetation and is undergoing extensive restoration. Once scraping activities have ceased and vegetation has been allowed to recover to a more natural state as determined by the HID Restoration Manager, an appropriate fire return interval would then be identified and incorporated into this measure accordingly.

Data Source:

Fire Ecologist, Everglades National Park

Everglades National Park Fire Management Plan

Data Adequacy:

High—Data quantity is complete and data quality is high because this measure is based on a long-term dataset. The Fire Management Program has been collecting this type of data since the 1950's, and accuracy has only been enhanced as technology has improved.

Frequency:

Minimum every five years. While data is available to calculate this measure on an annual basis, the fiveyear interval would coincide with national reporting requirements. However, park staff may choose to calculate this measure annually to provide a more complete picture.

Meaningful Change:

Because of extensive data availability, the threshold for meaningful change is based on regression analysis using a 90% confidence level (p-value <0.1). An increase in the measure value percentage beyond the threshold for meaningful change results in an improving trend in this measure.

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UNDEVELOPED QUALITY

NPS Photo, R. Cammauf

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NPS Photo, D. Carrillo

UNDEVELOPED QUALITY

Wilderness retains its primeval character and influence and is essentially without permanent improvement or modern human occupation.

The objective of monitoring the Undeveloped Quality is to assess whether a wilderness is becoming more developed over time, such as by exhibiting increasing presence of physical infrastructure, or if there is more prevalent use of mechanization, such as helicopter landings and use of chainsaws.

The opening sentence of the Wilderness Act, section 2(a) states that the National Wilderness Preservation System was created "In order to assure that an increasing population, accompanied by expanding settlement and growing mechanization, does not occupy and modify all areas within the United States…" Section 2(c) of the Wilderness Act defines wilderness as "an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements..." Agency policies and case law consistently identify the Undeveloped Quality as one of the principle components that defines wilderness. It is the most familiar and recognizable quality of wilderness for many people. Without buildings, roads, improvements on the landscape, or other evidence of modern civilization, the Undeveloped Quality speaks to the idea that wilderness is an area of undeveloped land.

Table 14 shows all measures selected to monitor the Undeveloped Quality in the MSD Wilderness and other lands managed as wilderness at Everglades National Park. The measures are described in detail below.

Table 14. Measures Selected for the Undeveloped Quality

Indicator	Measure	Frequency in Years	Data Adequacy	Meaningful Change	Baseline Data Value (year)	Current Data Value (year)
Presence of non-recreational structures, installations, and developments	Index of non-recreation physical developments	1	Medium	5% change Regression analysis after 5 values	1839.5 (ca. 2016)	TBD
Presence of inholdings	Number of inholdings	5	High	Any	5 inholdings (2015)	3 inholdings (2020)
Use of motor vehicles, motorized equipment, or mechanical transport	Index of authorized use of motorized equipment, mechanical transport, and motorized vehicles	1	Low	5% change (3 yr. rolling avg.) Regression analysis after 5 values	TBD	TBD

Two monitoring questions provide the broad context for monitoring the Undeveloped Quality:

1. What are the trends in non-recreational physical development?
2. What are the trends in mechanization?

The first monitoring question addresses the presence of physical development that most often typifies evidence of modern human occupation and modification, including both non-recreational physical developments and developments on lands interior to a wilderness not owned by the National Park Service (also known as inholdings). Developments associated with recreation, such as trails, bridges, signs, and campsites, are typically the most prevalent sign of modern human occupation and modification inside wilderness. However, recreational developments are not included under this quality, but are instead counted under the Solitude or Primitive and Unconfined Recreation Quality because their primary purpose relates directly to opportunities for primitive recreation. A basic tenet of Wilderness Character Monitoring is that measures are not double counted, but instead are listed under the quality and indicator where they fit best. The decision to include recreational developments under the Solitude or Primitive and Unconfined Recreation Quality was made in *Keeping It Wild 2* (Landres et al. 2015).

The second monitoring question assesses the effect of motorized equipment and mechanical transport on the Undeveloped Quality. This includes authorized uses, such as for administrative, emergency, and special provision purposes, as well as unauthorized uses. Although the Wilderness Act and subsequent legislation allow motorized equipment or mechanical transport under certain conditions, their use diminishes the Undeveloped Quality. Monitoring the use of motorized equipment and mechanical transport over time can help park staff make well-informed decisions grounded in the Wilderness Act.

The first monitoring question "What are the trends in non-recreational physical development?" is addressed through two indicators: (1) presence of non-recreational structures, installations, and developments, and (2) presence of inholdings. These two indicators provide a comprehensive assessment of the various types of physical developments not related to recreational infrastructure that may be present in a wilderness.

The second monitoring question, "What are the trends in mechanization?" is addressed through a single indicator that encompasses the use of motor vehicles, motorized equipment, or mechanical transport.

NPS Photo, H. Johnson

UNDEVELOPED QUALITY

Presence of non-recreational structures, installations, and developments

This indicator focuses on the physical evidence of modern human occupation and modification in wilderness, such as roads, buildings, and dams. This indicator excludes developments related to recreational use (e.g., trails) because they are counted under the Solitude or Primitive and Unconfined Recreation Quality.

Index of Non-Recreation Physical Developments

Measure Baseline Data Value: 1839.5 (ca. 2016)

Current Data Value: value TBD (year TBD)

Definitions:

- ***Installation***—anything made by humans that is not intended for human occupation and is left unattended or left behind when the installer leaves the wilderness.
- ***Structure***—anything made by humans that is intended for human occupation, or their possessions, and is left behind when the builder leaves the wilderness.

Background and Context:

The Wilderness Act defines wilderness as an area, "with the imprint of man's work substantially unnoticeable" (section 2(c)). Structures, installations, and roads directly impact the Undeveloped Quality by leaving signs of human presence and resource use. Developments as large as dams and as small as a tree tag are all non-recreational physical developments. Large numbers of smaller developments, such as PVC markers, can get lost overtime, and their exact location may become unknown. In contrast, large developments such as radio towers can be seen from great distances especially in flat topographic areas.

The MSD Wilderness and other lands managed as wilderness at Everglades National Park currently support a large number of non-recreational physical developments with a majority associated with on-

going research and restoration efforts. Long-term developments, such as water quality monitoring stations, aid staff in on-going restoration efforts that subsequently improve the Natural Quality of wilderness character. However, regardless of the purpose, any development in wilderness degrades the Undeveloped Quality of wilderness character.

Measure Description and Collection Protocol:

An index is used to calculate individual development ratings and measure component scores. Individual development ratings are numerical values for each feature monitored under this measure (e.g., the rating for one specific dam/plug). Some individual development ratings are determined by considering two different elements; for example, the rating for an instream installation accounts for the installation's "size" as well as "materials" used in its construction. These elements are described in detail below. Users should understand what developments and elements are counted under each measure component. At the bottom of this section, Table 15 provides the rating of each category for all the measure components in this index.

It is important to verify that individual features are only tracked under a single measure component and are not double counted. When developments can be reasonably attributed to multiple components, park staff will use their discretion to determine which component is less relevant and document who made the decision and why.

Measure component scores are the numerical values for each measure component, derived by summing the individual development ratings for all features monitoring under a component (e.g., the measure component score for all dams/plugs and other instream structures inside wilderness). The data value for the index is the sum of all measure component scores calculated for this measure. A decrease in the data value contributes to an upward trend in this indicator and benefits the Undeveloped Quality.

Measure Component: Structures

A structure is defined in NPS *Reference Manual #41,* Wilderness Definitions as "Anything made by humans that is intended for human occupation, or their possessions, and is left behind when the builder leaves the wilderness." Historical buildings are not included under this measure component. In addition, structures on inholdings or other non-NPS lands also are not included. The single element that is used to evaluate this component is size.

The size element is categorized by the gross area of a structure. The larger the building, the greater the impact on a visitor's sense of the undeveloped nature of wilderness character (to key off the phrase "substantially unnoticeable" in section 2(c) of the Wilderness Act).

The following categories are used to assess the size element:

- **Small**—structures with a gross area less than 500 square feet.
- **Moderate**—structures with a gross area between 500 and 1,000 square feet.
- **Large**—structures with a gross area greater than 1,000 square feet.

Currently, none of the structures in the MSD Wilderness and other lands managed as wilderness at Everglades National Park house people. Therefore, the scoring does not differentiate between unoccupied/abandoned/non-residential buildings and occupied buildings. Should some structures become occupied by people in the future, the measure would need to be updated to account for this change.

Measure Component: Dams, Plugs, and Other Instream Installations

Dams are defined as "any artificial barrier... which impounds or diverts water" (DOI Asset Codes; Version 4.2). This would include plugs (Figure 34). Other instream installations include constructed features found within a river channel, such as diversions, fish ladders, weirs, gaging stations, gates, water intake/outflow structures, canals/ditches, flumes, levees, and spillways. The two elements used to calculate individual development ratings for dams and instream structures are size and materials.

The size element is categorized by the type and scale of dams or instream structures. Instream structures that are not dams are generally smaller in scale and do not have as great an impact on the Undeveloped Quality. There are currently no dams in the MSD Wilderness and other lands managed as wilderness at Everglades National Park that meet the criteria for inclusion in the

National Inventory of Dams (NID). The NID contains information on large dams that either: (1) equal or exceed 25 feet in height and exceed 15 acre-feet in storage, (2) equal or exceed 50 acre-feet of storage and exceed 6 feet in height, or (3) are considered a significant hazard if they were to fail. The following categories are used to assess the size element:

- **Instream structures**—instream structures that are not dams, including: diversions, fish ladders, weirs, gaging stations, gates, water intake/outflow structures, canals/ditches, flumes, levees, spillways.
- **Dams not meeting NID criteria**—smaller dams that are not included in the NID.

The materials element is categorized by whether features are constructed from native or nonnative materials. The following categories are used to assess the materials element:

- **Native**—dams or instream structures constructed from native materials, such as earthen dams or features built of natural stone.
- **Nonnative**—dams or instream structures constructed from nonnative materials, such as more developed concrete or masonry features.

Measure Component: Administrative Roads

Roads are defined as "the main-traveled surface of a roadway open to motor vehicles, owned, controlled, or otherwise administered by the National Park Service." (36 Code of Federal Regulations 1.4). Most existing roads in wilderness occur in potential, proposed, or proposed potential wilderness. Administrative roads are included in this measure unless they have been converted to a system trail (in which case they are considered recreational and not counted here). Non-system roads are also tracked under this measure and may include ghost roads, user-created roads, and any road not considered part of the NPS road system. The two elements used to calculate individual development ratings for this component are cumulative length and complexity.

The cumulative length element is defined by the cumulative miles of road within wilderness. This element is without a cap limit to emphasize the full impact roads of various lengths have upon the Undeveloped Quality of wilderness character. An individual development rating is assigned to each ½-mile section of road in wilderness according to the complexity element. The distance of ½ mile was chosen to account for roads that are part of a grid or network where it would be difficult to determine where one road ends and another starts, such as the administrative roads in Pine Island District or in the East Everglades Addition.

The complexity element is categorized by the level of enhancement integrated into the road. Improved roads are likely to be more noticeable and will also likely need intervention to facilitate their removal from the landscape. Unimproved roads at grade are more likely to revegetate if given the opportunity. The following categories are used to assess the complexity element:

- **At Grade/Unimproved**—A road at the grade of the surrounding landscape and generally unimproved.
- **Raised/Enhanced**—A road comprised of a raised bed or enhanced in some other manner (e.g., paved, ditched).

Measure Component: Airboat Trails

Airboat trails are a visual scar upon the landscape, but airboats are oftentimes required to conduct administrative functions. Airboat trails to be acknowledged within this measure primarily include those officially recognized by the Park, such as administrative trails. Airboat use off officially recognized trails for a defined, short duration would not be captured within this measure as long as the use does not result in a trail that persists, as this falls below a threshold for what can be reasonably monitored. The single element used to calculate individual development ratings for this component is cumulative length.

The cumulative length element is defined by the cumulative miles of airboat trails within wilderness. This element is without a cap limit to emphasize the full impact airboat trails of various lengths have upon the Undeveloped Quality of wilderness. Airboat trails are scored for every 5-mile section rather than every ½-mile section like administrative roads because of their limited visual intrusion as well as the strong likelihood of airboat trails naturally revegetating when they are no longer in use. The following category is used to assess the cumulative length element:

- **Each 5-mile section**—The total miles of airboat trail in wilderness is aggregated and scored based on each 5-mile section.

Measure Component: Channel Markers

On the surface, channels and their associated markers would seemingly be connected with recreation, and therefore not be included in this measure. However, the primary purpose for these features is to protect the submerged marine wilderness from power boat propellers and for visitor safety. For this reason, channels and associated markers are included within this measure. The single element used to calculate individual development ratings for this component is the number of markers per channel.

The number of markers element is categorized by the number of markers associated with each channel.

The following categories are used to assess the number of markers element:

- ≤ 3—The total number of markers associated with a channel is less than or equal to 3.
- 4–10—The total number of markers associated with a channel fall between the range of 4 and 10.
- 11–25—The total number of markers associated with a channel fall between the range of 11 and 25.
- > 25–The total number of markers associated with a channel is greater than 25.

Measure Component: Fixed Instrumentation Sites and Markers

This protocol defines fixed instrumentation sites as unattended measurement devices left in place for at least one year. These sites typically contain measuring equipment, a data logger, and a power source. Some of these devices transmit data offsite for storage and analysis. Many types of instrumentation, such as trail counters for recreation use, automated cameras for wildlife, or wildlife collars or tags, may be temporarily installed at various locations around a wilderness for days, weeks, or in some cases, months. Such temporary installations do not have the same ability to affect the Undeveloped Quality due to their generally smaller scale and lack of permanence. For this component, only long-term fixed instrumentation sites in place for 12 months or more during the previous 5-year period are tracked. This time span covers related installations in place for an entire year, as well as recurring short-term instrumentations that are reinstalled seasonally for a cumulative total that meets or exceeds 12 months. For example, trail counters installed for 3 months each year, or 15 months in a 5-year period, would be counted here. This protocol further defines markers as installations that serve to mark a location of interest for non-recreational purposes. The single element that is used to evaluate this component is scale.

The scale element is categorized by the size and detectability of the fixed instrumentation site or marker to differentiate between the relative impacts of installations on the Undeveloped Quality. For fixed instrumentation sites, a site is counted a single time regardless of the number of different measurement devices that may be co-located. Devices and installations within 100 feet of one another are considered to be a single fixed instrumentation site.

The following categories are used to assess the scale element:

- **Barely discernible**—includes buried rebar, camouflaged tree tags, and other tiny markers or micro-instruments. While these are installations, this scoring system recognizes that a single installation of this type has a significantly lower impact than other categories in this component. The real impact of these installations lies in the cumulative effect of many such installations.
- **Unobtrusive**—includes larger instruments, plot markers, and monumentation that are easily visible from a short distance but generally not noticeable from greater distances. This category includes things like rebar with large end caps, PVC wells or piezometers that protrude a foot above the ground surface, or brightly colored plastic flagging or survey tape, which may be quite small but highly visible.
- **Obtrusive**—includes larger instruments that are visible from a greater distance, such as water or air samplers and medium-to-large boxes sheltering electronics.
- **Very obtrusive**—includes clusters of instruments and monumentation that are visible from a greater distance. Components that move and are, thereby, eye-catching (e.g., anemometer or wind turbine) will often place an installation into this impact category.

Measure Component: Communications and Utility Infrastructure

Utility infrastructure consists of two main types: point sites (e.g., repeater sites and telecommunication facilities) and linear features (e.g., water pipelines and telephone

lines). This measure component only includes utility infrastructure that is in place on a permanent basis (e.g., 12 months or more of cumulative time over a five-year period), and does not include infrastructure installed temporarily, such as repeaters installed to support fire management activities for a specific incident. Historical utility infrastructure, such as old water pipes and phone lines that are no longer in service should also be included when known. The single element that is used to evaluate this component is scale.

The scale element is categorized by the area and length of utility infrastructure to differentiate between the impacts of a small point site and a long utility corridor. The following categories are used to assess the scale element:

- **Small**—utility infrastructure that consists of an individual site occupying less than 1 acre in total size, such as a repeater site.
- **Moderate**—utility infrastructure that either: (1) consists of an individual site that equals or exceeds 1 acre, or (2) requires an above-ground linear corridor that is typically less than a ½ mile in length.

Table 15. Value for all Categories of Measure Components in Index

Measure Component	Category	Value
Structures	Small (<500 sq ft)	1
Structures	Moderate (500–1,000 sq ft)	2
Structures	Large (>1,000 sq ft)	3
Dams, Plugs, and Other Instream Installations	Instream structure; Native materials	1
Dams, Plugs, and Other Instream Installations	Instream structure; Nonnative materials	2
Dams, Plugs, and Other Instream Installations	Dam not meeting NID criteria; Native materials	3
Dams, Plugs, and Other Instream Installations	Dam not meeting NID criteria; Nonnative materials	6
Roads	Each ½-mile section; At Grade / Improved	2
Roads	Each ½-mile section; Raised / Enhanced	4
Airboat Trails	Each 5-mile section	2
Channel Markers	Marked Channel with ≤ 3 Markers	1
Channel Markers	Marked Channel with 4–10 Markers	2
Channel Markers	Marked Channel with 11–25 Markers	3
Channel Markers	Marked Channel with > 25 Markers	4
Fixed Instrumentation and Markers	Barely Discernible	0.5
Fixed Instrumentation and Markers	Unobtrusive	1
Fixed Instrumentation and Markers	Obtrusive	2
Fixed Instrumentation and Markers	Very Obtrusive	3
Communications + Utility Infrastructure	Small (point site <1 acre)	2
Communications + Utility Infrastructure	Moderate (point site ≥1 acre or linear feature <½ mile)	5

Data Source:

Consult minimum requirements analyses, new research permits, NEPA documents, GIS files, and associated staff members for new and additional non-recreation developments.

- Wilderness Coordinator, Everglades National Parks
- GIS Specialist, South Florida National Parks
- Chief of Cultural Resources, Everglades and Dry Tortugas National Parks
- Facility Management Software System

Data Adequacy:

Medium—The data quantity is partial because a centralized database does not exist in which all non-recreation developments are documented. A centralized database would provide more assurance that all the data of non-recreational development has been or is being collected. Data will come from multiple locations and some non-recreation developments may be missed.

The data quality is moderate because available data is accurate as of the time it was collected but is updated infrequently or is incomplete.

Frequency:

Data is monitored and compiled at least annually to ensure data accuracy. Every five years, changes to the components of the development index are assessed, and the component scores and total index value are calculated.

Meaningful Change:

A 5% or greater change in the measure value will result in a change in trend for this measure. Once there are five measure values, the threshold for meaningful change will switch to regression analysis, and statistical significance will determine the trend in the measure. A decrease in the development measure value corresponds with an improving trend.

Figure 33. Example of a canal plug.

UNDEVELOPED QUALITY

NPS Photo, D. Diaz

Presence of inholdings

This indicator focuses on the physical evidence of modern human occupation and modification within inholdings. Due to the vulnerability of these lands to development and the adverse effect this development could have on the surrounding wilderness values, the impact on the Undeveloped Quality of wilderness character can be significant.

Number of Inholdings

Measure Baseline Data Value: 5 inholdings (2015)

Current Data Value: 3 inholdings (2020)

Definitions:

- ***Inholding***—a parcel of land not owned by the federal land managing agency that is entirely surrounded by designated wilderness.

Background and Context:

Inholdings in wilderness are extremely vulnerable to development that would likely have an adverse effect on the surrounding wilderness values. Inholdings are not subject to the same laws and policies as wilderness lands. Access to inholdings can encourage mechanized and motorized use in the wilderness via access roads, and inholdings can encourage developments and incompatible uses and activities.

Three inholding parcels exist within designated wilderness in the Gulf Coast District. These parcels, covering approximately 50 acres, are part of one property. Two inholding properties in East Everglades were purchased and finalized in November 2016. Current mineral rights do exist. These rights are subsurface and are owned by many different people. However, all the physical land that the rights sit under is owned by the National Park Service. If mineral rights were pursued for development the park may block the activity and look for alternatives to obtain ownership.

Measure Description and Collection Protocol:

The data value for this measure is the number of privately-owned inholdings in wilderness. Acreage is not used for this measure because there are no current inholdings within wilderness and the establishment of future inholdings is unlikely. An increase in the number of inholdings contributes to a downward trend in this indicator and impacts the Undeveloped Quality.

Data Source:

- GIS Specialist, South Florida National Parks
- NPS Lands Database
- Park Planner, Everglades National Park

Data Adequacy:

High—The data quantity is complete, and the data quality is high.

Frequency:

Every five years.

Meaningful Change:

Any.

NPS Photo

UNDEVELOPED QUALITY

Use of motor vehicles, motorized equipment, or mechanical transport

This indicator focuses on the use of the three forms of mechanization discussed in section 4(c) of the Wilderness Act: (1) motor vehicles, (2) motorized equipment, and (3) mechanical transport.

Index of Authorized Use of Motor Vehicles, Motorized Equipment, and Mechanical Transport

Measure Baseline Data Value: value TBD (year TBD)

Current Data Value: value TBD (year TBD)

Definitions:

- ***Administrative use***—use authorized by the National Park Service that is considered to be necessary to meet minimum requirements for the administration of the area.
- ***Authorized***—includes all agency staff as well as personnel under current permits or agreements with Everglades National Park. These authorizations generally include, but are not limited to, a Minimum Requirements Analysis, National Environmental Policy Act decision document, permit, supervisor's approval, and/or the superintendent's approval.
- ***Aircraft, Landing of***—bringing down to the surface of the earth (land, water, snow, ice) any aircraft or anything attached to or carried by an aircraft, during or after flight
- ***Mechanical transport***—any contrivance for moving people or material in or over land, water, snow, or air that has moving parts and is powered by a living or non-living power source. This includes (but is not limited to) wheeled

vehicles, devices, or contrivances, such as bicycles, Segways™ and other Electric Personal Assistance Mobility Devices, game carriers, travois, carts, wheelbarrows, and wagons. "Mechanical transport" does not include skis, snowshoes, sleds, travois, nonmotorized river craft including drift boats, rafts, or canoes, or similar primitive devices. Wheelchairs or other mobility devices that meet the definition of "wheelchair" in the Americans with Disabilities Act, section 508(c) are not prohibited in wilderness.

- ***Motorboat***—any type or description of craft, other than a seaplane on water, used or capable of being used as a means of transportation on water that is powered by a motor, engine, or other non-living power source. This includes but is not limited to, airboats and personal watercraft.
- ***Motor vehicle***—any vehicle that is self-propelled, including any vehicle that is propelled by electric power but not operated on rails or upon water. This includes, but is not limited to cars, trucks, all-terrain vehicles (ATV) and motorcycles.
- ***Motorized equipment***—any machine that applies force by transferring energy from a motor, engine, or other non-living power source. This includes but is not limited to, such machines as aircraft, drones, snowmobiles, motorboats, chainsaws, weed whackers, power drills, power saws, generators, compressors, windmills or turbines, and now or leaf blowers. "Motorized equipment" does not include shaves, wrist watches, clocks, flashlights, cameras, camping stoves, solar panels, batteries, explosives, Geiger counters, cellular telephones, portable electric media devices, radio receivers or transmitters, GPS units, or other similar small, battery-powered, hand-carried personal camping equipment.

Background and Context:

The undeveloped character of wilderness is unique in that it runs through every definition of wilderness (Landres et al. 2015). The Wilderness Act states that a wilderness is to be, "in contract with those areas where man and his own works dominate the landscape" (section 2(c)). It goes on to say that motorized equipment, motor vehicles, motorboats, the landing of aircraft, and other forms of mechanical transport are prohibited, except as necessary for the administration of the area for the purposes of Wilderness (section 4(c)). These uses are permitted only if deemed necessary through a Minimum Requirements Analysis.

These uses are oftentimes frequent in the MSD Wilderness and other lands managed as wilderness at Everglades National Park, but that isn't to say they aren't justified. This Wilderness plays a role in the South Florida Ecosystem Restoration effort, one of the largest restoration efforts in the world. Data collection to support the restoration effort are crucial for park management when negotiating with stakeholders at the landscape level, many of whom have priorities that differ from the park's goal of enhancing the Natural Quality. Due to the expansive nature of the wilderness, combined with its extreme environmental conditions, much of the wilderness is inaccessible by traditional means within the requisite constraints of most data collection efforts. This results in the need for motorized access into the interior of the wilderness, generally in the form of a helicopter or airboat. That being said, park managers will continue to evaluate requests for these uses to ensure that they are the minimum required. This measure is intended to monitor the trend in use over time.

Measure Description and Collection Protocol:

This measure assesses the three-year rolling average of a use-level index evaluating administrative authorizations to use motor vehicles, motorized equipment (including motorboats and landing of aircraft such as helicopters), or mechanical transport, based on the type and number of pieces of equipment and the days of use. This index is consistent with the strongly encouraged measure for this indicator in the draft NPS "Wilderness Character Monitoring Technical Guide" (n.d.). Administrative use is defined as use authorized by the National Park Service that is considered to be necessary to meet minimum requirements for the administration of the area. This includes administrative motorized and mechanized uses conducted by agency staff, as well as by other individuals as authorized under current permits or agreements with the National Park Service. The use of motor vehicles, motorized equipment, and mechanical transport for emergency response and incident management is also included here, as these management actions have an impact on the Undeveloped Quality even if the action is deemed necessary.

Data to be collected for the purposes of this measure include equipment type, number of pieces of equipment, number of days of use, and dates of use. Any other identifiers that indicate the project or purpose for which the equipment was used should also be included. Various equipment types have been compiled into broad categories based on the different degrees of mechanical advantage they provide. This reflects the level of enhanced ability each equipment type permits "man and his own works [to] dominate the landscape." Equipment that is primarily human-powered and/or smaller in impact to the social and biophysical resources inside wilderness (e.g., noise, ground disturbance, visual impact), helping to retain greater primeval character, has been assigned a lower "Inherent Weight." If the "Equipment Type" attribute is expanded in the future to include additional types of motorized equipment and mechanical transport, associated "Inherent Weight" values must also be assigned at the same time (Table 16). In such circumstances in which motorized equipment is attached to mechanical transport (e.g., terra torch on ATV, pump on fire engine) they are counted as one piece of equipment; however, they may be reassigned to a higher inherent weight at the discretion of appropriate park staff depending on the level of enhancement provided by the combined equipment.

Table 16. Inherent Weight of Equipment Types

Equipment Type (Examples)	Inherent Weight
Battery-powered hand tool, bicycle, canoe dolly, hand truck, horse-drawn wagon, wheelbarrow, wheeled litter, etc.	1
Air compressor, electroshocker, generator, leaf blower, motorized winch, portable pump, welder, motorized torch, etc.	2
All-terrain vehicle, truck, motorcycle, chainsaw, brush cutter, concrete mixing equipment, unmanned aerial system (deployment and/or retrieval of), landing of aircraft, motorized watercraft, airboat, power auger, rock drill, etc.	3
Heavy equipment (e.g., bulldozer, dump truck), fire engine, marsh master, swamp buggy, etc.	4

A decrease in the three-year use level index results in an upward trend in this measure and benefits the Undeveloped Quality.

Data Source:

- NPS staff and permittees that use motor vehicles, motorized equipment, and/or mechanical transport in wilderness areas.
- Completed MRAs will also be referenced to determine authorized amounts and who should be contacted to obtain actual numbers.

Data Adequacy:

Low—Data quantity is insufficient because this data is not currently required to be recorded by individuals to this degree, and the data is not collected or recorded in a centralized location. The data quality is moderate because overall project documentation does exist.

Frequency:

Data are compiled and analyzed annually due to the variable nature of administrative authorizations.

Meaningful Change:

The threshold for meaningful change is a 5% change in the three-year rolling average measure value. Park staff chose a three-year rolling average to account for potential annual variability in the data set while still being able to detect subtle changes over time which may be unnoticeable by averaging over a longer timeframe. Once there are five measure values, the threshold for meaningful change will switch to regression analysis. A decrease in the three-year rolling average beyond the threshold for meaningful change results in an improving trend in this measure.

Solitude or Primitive and Unconfined Recreation Quality

NPS Photo, C. Rivas

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NPS Photo, C. Rivas

SOLITUDE OR PRIMITIVE AND UNCONFINED RECREATION QUALITY

Wilderness provides outstanding opportunities for solitude or primitive and unconfined recreation.

The objective of monitoring the Solitude or Primitive and Unconfined Recreation Quality is to assess whether management of a wilderness is trending over time towards protecting outstanding opportunities for specific, unique recreational experiences. This monitoring focuses on three aspects of the quality:

1. Solitude
2. Primitive Recreation
3. Unconfined Recreation

As populations increase and technology advances, wilderness provides opportunities for solitude and for a primitive or unconfined type of recreation that are not available in many other places. Wilderness is unique in that its managers are mandated to provide outstanding opportunities for a specific type of recreational experience. Although managers cannot guarantee or require that visitors experience solitude or primitive and unconfined recreation, they must protect conditions that promote such opportunities. The Solitude or Primitive and Unconfined Recreation Quality focuses on the tangible aspects of the setting that affect the visitor experience, and not on the subjective nature of the visitor experience itself. There are many intangible aspects of wilderness recreation (e.g., challenge, self-reliance, self-discovery) that are not included under this quality but that are still integral to the wilderness experience.

Table 17 shows all measures selected to monitor the Solitude or Primitive and Unconfined Recreation Quality in the MSD Wilderness and other lands managed as wilderness at Everglades National Park. The measures are described in detail below.

Table 17. Measures for Solitude or Primitive and Unconfined Recreation Quality

Indicator	Measure	Frequency in Years	Data Adequacy	Meaningful Change	Baseline Data Value (year)	Current Data Value (year)
Remoteness from sights and sounds of human activity inside wilderness	Acres of wilderness away from access and travel routes and developments inside wilderness	5	High	3% change Regression analysis after 5 values	759,960 (ca. 2006)	TBD
Remoteness from sights and sounds of human activity outside the wilderness	Acres of wilderness away from adjacent travel routes and developments outside the wilderness	5	High	3% change Regression analysis after 5 values	646,149 (ca. 2006)	TBD
Remoteness from sights and sounds of human activity outside the wilderness	Night sky visibility	5	High	Any Change in Class	21.05 mag arcsec^{-2} (2010, 2014) Slightly Degraded	21.05 mag arcsec^{-2} (2010, 2014) Slightly Degraded
Facilities that decrease self-reliant recreation	Number of authorized constructed or improved recreation features	5	Medium	Any Change	120 (1981)	60 (2021)
Management restrictions on visitor behavior	Index of visitor use management restrictions	5	High	Any Change	24 (1988)	23 (2020)

Two monitoring questions are used in monitoring the Solitude or Primitive and Unconfined Recreation Quality:

1. What are the trends in outstanding opportunities for solitude?
2. What are the trends in outstanding opportunities for primitive and unconfined recreation?

The first monitoring question addresses the experience of solitude. The Wilderness Act recognizes that wilderness, protected from human development or settlement, can provide an opportunity for solitude not available elsewhere. Opportunities for solitude are degraded by both visitor use in wilderness and characteristics that alter the natural setting. Specifically, encountering other visitors in wilderness, or seeing or hearing the signs of modern civilization, may detract from opportunities to experience solitude. To address this monitoring question, two indicators are used: (1) remoteness from sights and sounds of human activity inside wilderness, and (2) remoteness from sights and sounds of human activity outside wilderness. Using two indicators for remoteness allows managers to assess conditions that are subject to management control separately from those that are outside of management control.

The second monitoring question addresses the primitive and unconfined nature of wilderness experiences. The inclusion of primitive and unconfined recreation as a separate monitoring question recognizes the importance of nonmotorized and non-mechanized travel, self-reliance and self-discovery, and the need for places where people can be free from social constraints. Because primitive recreation requires self-reliance and skills in wilderness travel, opportunities for such experiences are degraded by the presence of facilities that make wilderness travel easier, such as boardwalks and improved campsites. Unconfined recreation encompasses the sense of discovery, adventure, and mental challenge where visitors can travel and explore unique and unknown environments on their own. To address this monitoring question, two indicators are used, one each for primitive recreation (facilities that decrease self-reliant recreation) and unconfined recreation (management restrictions on visitor behavior).

NPS Photo, A. Sanchez

SOLITUDE OR PRIMITIVE AND UNCONFINED RECREATION QUALITY

Indicator: Remoteness from sights and sounds of human activity *inside* wilderness

This indicator assesses wilderness visitation and the capacity of a wilderness setting to allow for escape from the sights and sounds of human activity. The opportunity to achieve solitude is addressed as a function of both the density and location of visitors within wilderness—most of whom stay near established trails, destinations, and pre-existing campsites—as well as the opportunity to get away from those visitors and their impacts by accessing more remote areas.

Acres of Wilderness Away from Access and Travel Routes and Developments Inside Wilderness

Measure Baseline Data Value: 835,552 acres (ca. 2006)

Current Data Value: value TBD (year TBD)

Definitions:

- ***Very obtrusive***—a class of instrumentation that includes clusters of instruments and monumentation that are visible from a greater distance. Components that move and are, thereby, eye-catching (e.g., anemometer or wind turbine) will often place an installation into this impact category. See the index of non-recreation physical developments measure for additional context.

Background and Context:

Travel routes can impact solitude beyond their physical location. The visual and audio disturbance can carry across wilderness to reduce a visitor's sense of solitude. Calculating the acres of wilderness away from access and travel routes and developments indicates what proportion of the wilderness provides for different opportunities for solitude.

Measure Description and Collection Protocol:

This measure assesses the total number of wilderness acres located more than ½ mile from access points, travel routes (e.g., authorized trails and roads, aircraft landing sites), and developments inside wilderness. Acreage associated with the submerged marine land wilderness is excluded from this measure. This measure is intended to capture impacts to opportunities for visitors to experience solitude in wilderness. Visitor opportunities are essentially nonexistent on submerged wilderness lands, and most visitor activities in this area occur on the water surface which is not designated as wilderness. This is not to diminish the importance of the submerged wilderness but to reflect the reality of visitor opportunities for solitude in these areas. The distance of ½ mile is somewhat arbitrary because the visual and audible impacts of roads and developments depend largely on topography and vegetation, among other factors. However, using a consistent buffer allows for the determination of trends over time.

First, users must understand what types of routes and developments are counted under this measure and retrieve the appropriate spatial data. Table 18 lists the types of routes and developments that are and are not included in this measure.

Table 18. Routes and Developments Inside Wilderness to Include or Exclude During Assessment

Category	Included	Not Included
Access and travel routes	• Authorized hiking trails • Marked paddling routes • Motorized travel routes (e.g., roads, ATV trails) • Airboat Trails	• Unauthorized (user-created) trails • Aircraft landing sites • Aircraft travel routes over wilderness • Trails and routes in areas designated as submerged wilderness
Developments	• Authorized recreation sites and features (e.g., designated campsites, bridges, toilets) • Administrative developments (e.g., administrative buildings) • Fixed instrumentation categorized as Very Obtrusive per Index of non-recreation physical developments measure (Undeveloped Quality) • Utility Infrastructure (e.g., radio repeaters, cell towers)	• Archaeological and historical sites (unless in active use for administrative or recreational purposes) • Unauthorized (user-created) recreation sites • Fixed instrumentation categorized at Barely Discernable, Unobtrusive, or Obtrusive per Index of non-recreation physical developments measure (Undeveloped Quality)

There is the possibility of confusion about whether to include travel routes and developments that are on the boundary of a wilderness (including cherry-stemmed roads) under this measure or under the related measure *Acres of Wilderness away from Adjacent Travel Routes and Developments Outside the Wilderness*. Travel routes and developments should only be included in one of the measures, not both. Features located on the boundary should only be included in the measure *Acres of Wilderness away from Adjacent Travel Routes and Developments Outside the Wilderness*.

The MSD Wilderness includes submerged marine lands, which are a special case. The submerged marine (marine waters) portion, approximately 530,000 acres in extent, is unusual in that it includes the marine bottom (benthic surface), but not the water column or the water surface. This distinction allows motorboating on the water surface. Therefore, trails and routes in the submerged marine portion of the MSD Wilderness are not included as part of this measure because travel on these routes is occurring outside wilderness.

The spatial data used for this measure may come from a variety of data sources. If necessary, users should contact a GIS specialist to assist with this measure. Given questions about the completeness and accuracy of spatial data, a map should be validated once all data have been located. Wilderness and resource specialists should review the map for accuracy and completeness and identify any routes or developments that are missing or incorrect. The iterative process of evaluating and correcting the map of routes and developments inside wilderness is most critical for the measure baseline year.

To perform the spatial analysis and calculate the data value for this measure, first buffer all identified routes and developments inside wilderness by ½ mile. Subtract the buffered area from the wilderness polygon (sans submerged marine land wilderness), and then calculate the remaining area to determine the acres of wilderness away from internal routes and developments (Figure 35).

Data Source:

Park GIS Specialists

Research Permit Files

Facility Management Software System (FMSS)

Data Adequacy:

High—The data quantity is complete with the possible exception of some fixed instrumentation, and data quality is good due to the efforts of park GIS specialists.

Frequency:

Every five years.

Meaningful Change:

The threshold for meaningful change is a 3% change in the acres of wilderness away from access and travel routes and developments inside wilderness. Once there are five measure values, the threshold for meaningful change will switch to regression analysis. An increase in the number of wilderness acres beyond the threshold for meaningful change results in an improving trend in this measure.

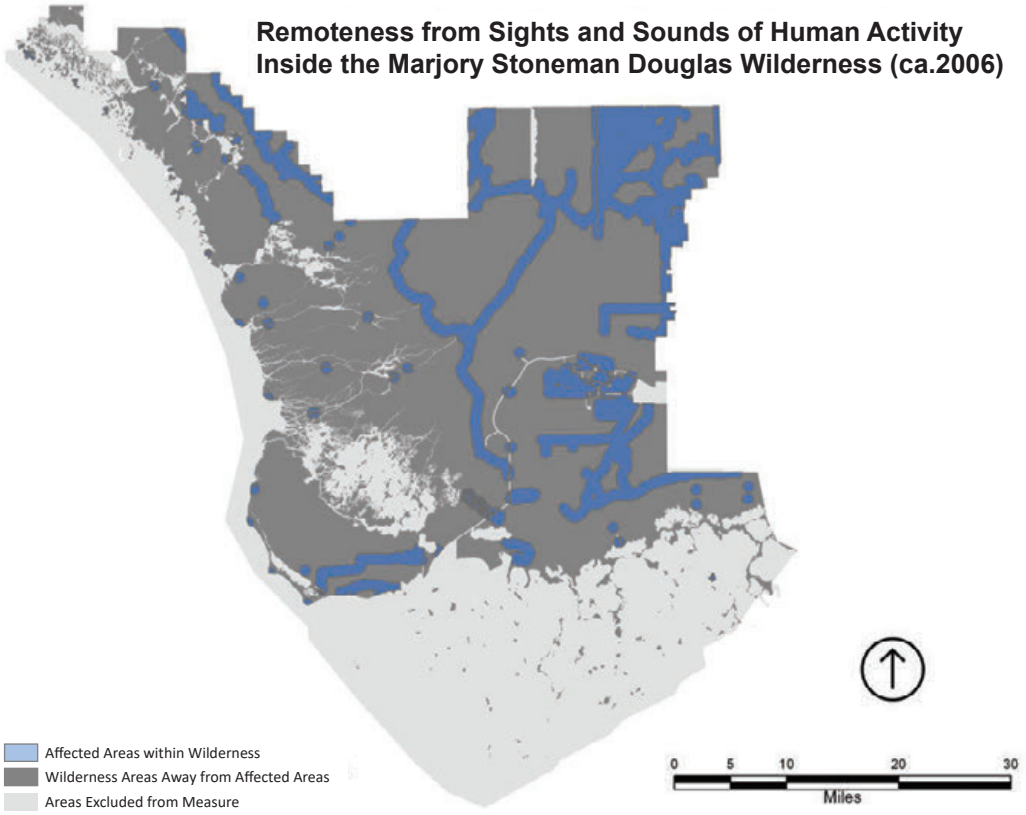

Figure 34. Map showing areas of wilderness within 1/2 mile of and more than 1/2 mile away from travel routes and developments inside the wilderness (circa 2006). Note that a wilderness study was being conducted on the East Everglades Addition during this time and is therefore its entire acreage is included.

NPS Photo, P. Palma

SOLITUDE OR PRIMITIVE AND UNCONFINED RECREATION QUALITY

Indicator: Remoteness from sights and sounds of human activity *outside* the wilderness

This indicator focuses on human activity occurring outside or on the boundary of a wilderness that is visible or audible from within wilderness. Although legal protections and restrictions of wilderness do not extend to activities occurring outside a wilderness boundary, these activities can still degrade the wilderness experience.

Acres of Wilderness Away from Adjacent Travel Routes and Developments Outside Wilderness

Measure Baseline Data Value: 753,327 (ca. 2006)

Current Data Value: value TBD (year TBD)

Definitions:

Very obtrusive—a class of instrumentation that includes clusters of instruments and monumentation that are visible from a greater distance. Components that move and are, thereby, eye-catching (e.g., anemometer or wind turbine) will often place an installation into this impact category. See the index of non-recreation physical developments measure for additional context.

Background and Context:

Outside travel routes and developments may disturb the visual and audio experience of a wilderness user. This measure is relevant to the indicator because it monitors selected conditions occurring on lands adjacent to the wilderness that affect visitors' opportunities for solitude. Even though managers may not be able to take action to mitigate or prevent increases to access/travel routes

on adjacent non-park or non-wilderness lands, they nonetheless provide a direct measure of the indicator.

Measure Description and Collection Protocol:

This measure assesses the total number of wilderness acres located more than ½ mile from roads, structures, and other developments that are located outside a wilderness or on the boundary, including cherry-stemmed access road corridors and developed inholdings. For consistency, the same buffer is used for the measure, "Acres of Wilderness Away from Access and Travel Routes and Developments Inside Wilderness."

Acreage associated with the submerged marine land wilderness is excluded from this measure. This measure is intended to capture impacts to opportunities for visitors to experience solitude. Visitor opportunities are essentially nonexistent on submerged wilderness lands, and most visitor activities in these areas occur on the water surface which is not designated as wilderness. This is not to diminish the importance of the submerged wilderness but to reflect the reality of visitor opportunities for solitude in these areas.

First, users must understand what types of routes and developments are counted under this measure and retrieve the appropriate spatial data. Table 19 lists the types of routes and developments that are and are not included in this measure.

Table 19. Routes and Developments Outside Wilderness to Include or Exclude During Assessment

Category	Included	Not Included
Access and travel routes	• Authorized hiking trails • Motorized travel routes (e.g., roads, ATV trails) • Airboat Trails • Motorboat Accessible Areas (excluding pole/troll/no motor zones)	• Unauthorized (user-created) trails • Aircraft landing sites • Aircraft travel routes over wilderness
Developments	• Authorized recreation sites and features (e.g., designated campsites, bridges, toilets) • Administrative developments (e.g., administrative buildings) • Housing and tourism developments • Fixed instrumentation categorized at Very Obtrusive per Index of non-recreation physical developments measure (Undeveloped Quality) • Utility Infrastructure (e.g., radio repeaters, cell towers)	• Archaeological and historical sites (unless in active use for administrative or recreational purposes) • Unauthorized (user-created) recreation sites • Fixed instrumentation categorized at Barely Discernable, Unobtrusive, or Obtrusive per Index of non-recreation physical developments measure (Undeveloped Quality)

There is the possibility of confusion about whether to include travel routes and developments that are on the boundary of a wilderness (including cherry-stemmed roads) under this measure or under the related measure *Acres of Wilderness away from Adjacent Travel Routes and Developments Inside Wilderness*. Travel routes and developments should only be included in one of the measures, not both. Features located on the boundary should be included in this measure. Likewise, travel routes and developments on inholdings should also be included in this measure because inholdings are, by definition, not part of a wilderness. Similarly, trails and routes above the submerged marine portion of the MSD Wilderness are included as part of this measure because travel on these routes is occurring outside wilderness but has an effect on nearby wilderness areas, including the submerged marine wilderness.

The spatial data used for this measure may come from a variety of data sources. If necessary, users should contact a GIS specialist to assist with this measure. Given questions about the completeness and accuracy of spatial data, a map should be validated once all data have been located. Wilderness and resource specialists should review the map for accuracy and completeness and identify any routes or developments that are missing or incorrect. The iterative process of evaluating and correcting the map of routes and developments inside wilderness is most critical for the measure baseline year.

To perform the spatial analysis and calculate the data value for this measure, first buffer all identified routes and developments outside wilderness by ½ mile. Subtract the buffered area from the wilderness polygon (sans submerged marine land wilderness), and then calculate the remaining area to determine the acres of wilderness away from external routes and developments (Figure 36).

Data Source:

- Park GIS Specialists
- Research Permit Files
- Facility Management Software System

Data Adequacy:

High—The data quantity is complete with the possible exception of some fixed instrumentation, and data quality is good due to the efforts of park GIS specialists.

Frequency:

Every five years.

Meaningful Change:

The threshold for meaningful change is a 3% change in the acres of wilderness away from access and travel routes and developments outside the wilderness. Once there are five measure values, the threshold for meaningful change will switch to regression analysis. An increase in the number of wilderness acres beyond the threshold for meaningful change results in an improving trend in this measure.

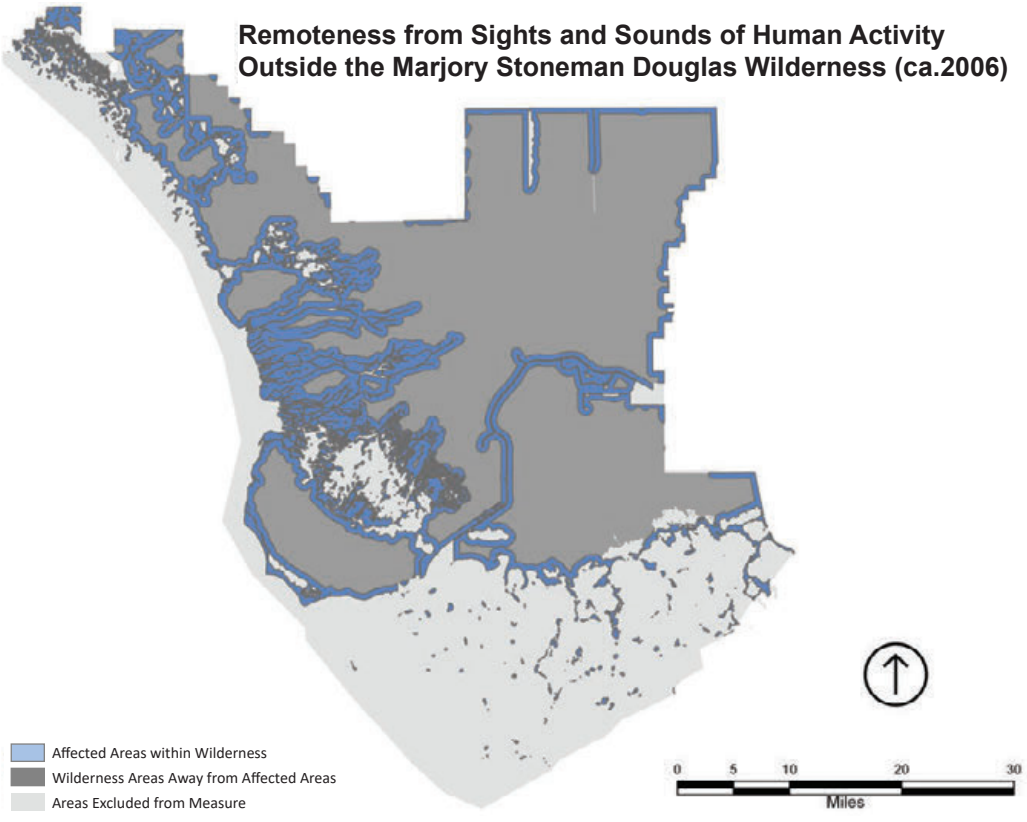

Figure 35. Map showing areas of wilderness within 1/2 mile of and more than 1/2 mile away from travel routes and developments outside the wilderness (circa 2006). Note that a wilderness study was being conducted on the East Everglades Addition during this time and is therefore included in its entirety.

Night Sky Visibility

Measure Baseline Data Value: 21.05 mag arcsec-2 (2014)

Current Data Value: 21.05 mag arcsec-2 (2014)

Figure 36. Visitors photograph the night sky at a park Dark Sky Event.

Definitions:

- ***Synthetic SQM***—the "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. . .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" (NPS n.d.b.).

Background and Context:

Starry night skies and darkness are important natural resources of national parks as they hold some of the last remaining harbors of darkness and provide an excellent opportunity to the public to experience this endangered resource (NPS n.d.a.). All night skies free of light pollution provide a visible sense of remoteness, contributing to the solitude and primitive aspects of wilderness character. Light pollution impacts wilderness character from a human perspective as it is a constant visual reminder of developed society. This artificial brightening of the night reduces levels of contrast between stars and space, obscuring the glow of stellar objects and preventing the human eye from fully adapting to darkness. Light pollution also impacts entire ecosystems by disrupting natural patterns of light and dark navigation, influencing predator-prey relationships, disrupting nocturnal wildlife, and even altering light-sensitive species such as sea turtles (NPS n.d.a.).

The MSD Wilderness and other lands managed as wilderness at Everglades National Park provide outstanding opportunities to experience night skies even with its proximity to the Miami metropolitan area (Figure 37). The park is largely surrounded by the Atlantic Ocean, Gulf of Mexico, and agricultural fields which limits urban development opportunities.

Additionally, the park's wilderness encompasses nearly 1.5 million acres, putting a large land buffer between urban development and the night sky viewing opportunities. While there are potential threats to night skies from non-wilderness areas within park boundaries, the biggest threat to the park's night sky is increased urban and industrial development as it continues to encroach and move west from the Miami metropolitan area and southeast from Naples toward the park boundaries.

Measure Description and Collection Protocol:

The data value is the sum average of the synthetic SQM value reported for each site location. Data and site locations are produced by the NPS Natural Sounds and Night Skies Division (NSNSD) (Table 20). An increase in this data value results in an upward trend in this measure and benefits the Solitude or Primitive and Unconfined Recreation Quality. Table 21 below provides the night sky classification standards; a value of 21.05 mag arcsec-2 represents a "slightly degraded" night sky.

Table 20. Night Sky Visibility Data for Everglades National Park

Site Name	Date	Long.	Lat.	Elev. (m)	Bortle Class	Synthetic SQM	SQI All-Sky	# of Stars Visible
Gulf Coast VC	12/6/2010	-81.39	25.84	2	n/a	20.82	45.5	2160
East Cape Sable	02/28/2014	-81.09	25.12	1	4	21.35	80.6	3470
Flamingo	12/01/2010	-80.94	25.14	3	n/a	21.57	81.4	3340
Pahayokee Overlook	02/28/2014	-80.78	25.44	3	5	20.92	43.6	2110
Shark Valley Observation Tower	03/01/2014	-80.77	25.66	11	5	20.61	36.6	1890

While the data provided by the NSNSD is excellent, surveys are extremely infrequent (>5 years). Furthermore, survey locations are not representative of the wilderness as a whole and are generally located near easily accessible areas due to time limitations. It is recommended that future survey locations be distributed throughout the wilderness to provide a good representation of night sky quality. Suggested sites include Jewell Key, Lostman's Key, East Cape Sable, Little Rabbit Key, Shark Valley Tower, Pa-hay-okee, West Lake, and North Nest Key. It is also recommended that the park schedule surveys at least every five years through NSNSD. This survey could be requested by the wilderness coordinator, with park managers' approval, through the Solution for Technical Assistance Requests (STAR) application at http://irma.nps.gov/Star/.

Another option is for the park to acquire Unidedron Sky Quality Meters or similar devices and implement a local night sky survey program. Surveys could then be conducted once or twice per year near the new moon cycle to ensure the brightness of the moon does not affect values. The SQM values collected by the Sky Quality Meters would be averaged in a similar fashion to calculate the data value. Should a night sky monitoring program be established, the first year's data would become the new baseline in order to avoid any discrepancy due to the survey locations and methodology.

Data Source:

National Park Service's Night Sky Monitoring Database

- Instructions on how to obtain night sky data are outlined on the following website step-by-step. https://www.nps.gov/subjects/nightskies/skymap.htm.

International Dark-Sky Association (IDA) Dark Sky Reserve Designation Guidelines

- https://www.darksky.org/wp-content/uploads/2018/06/IDSR_Guidelines_Oct2015.pdf

Overview of Bortle's Dark Sky Scale

- https://www.nps.gov/subjects/nightskies/upload/BortleDarkSkyScale-2.pdf

How to conduct a sky quality survey

- https://www.darksky.org/our-work/conservation/idsp/become-a-dark-sky-place/sky-quality-survey/

Data Adequacy:

High—Data quantity is complete and data quality is good because an accurate measure of the photic environment was taken by national experts.

Frequency:

Every five years. There is no regularly scheduled assessment of Everglades National Park night sky visibility. Measurements require the assistance of the NPS Natural Sounds and Night Skies Division and must be requested by park staff through the Solution for Technical Assistance Requests (STAR) application at http://irma.nps.gov/Star/. New data should be recorded as they are made available but more than every five years.

Meaningful Change:

Any change from one classification in Table 21 to another is considered a meaningful change.

Table 21. Night Sky Classification Standards

SQM Value	Bortle Sky Class	IDA Tier Designation	Classification
> 21.75	1–3	Gold	"Natural"
21.74–21.00	3–5	Silver	Slightly Degraded
20.99–20.00	5–6	Bronze	Degraded
< 19.99	6–9	–	Severely Degraded

*These standards are adopted from the Dark Sky Reserve Designation Guidelines established by the International Dark-Sky Association (IDA).

The following three figures (Figure 38, Figure 39, and Figure 40) are data images produced by NSNSD shown in false color with yellow, red, and white corresponding to brighter sky while blue, purple, and black correspond to darker sky (NPS n.d.a.).

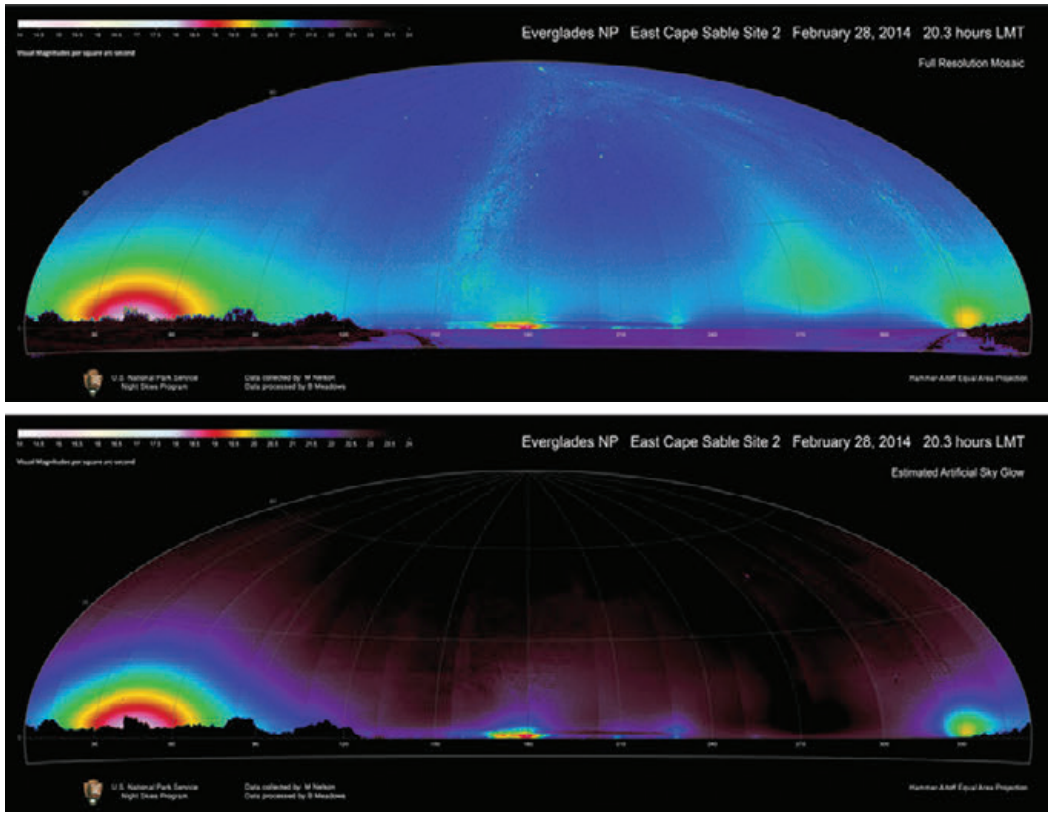

Figure 37. Observed (top) and estimated (bottom) artificial sky brightness mosaics at East Cape Sable.

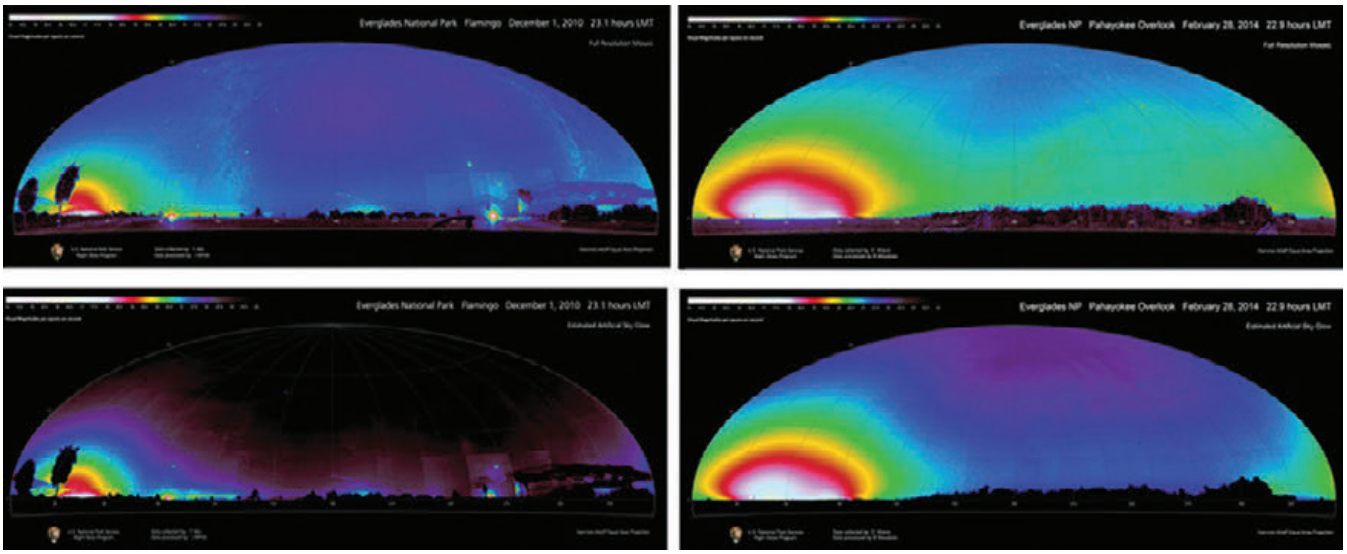

Figure 39. Observed (top left and top right) and estimated (bottom left and bottom right) artificial sky brightness mosaics at Flamingo (left) and Pahayokee Overlook (right).

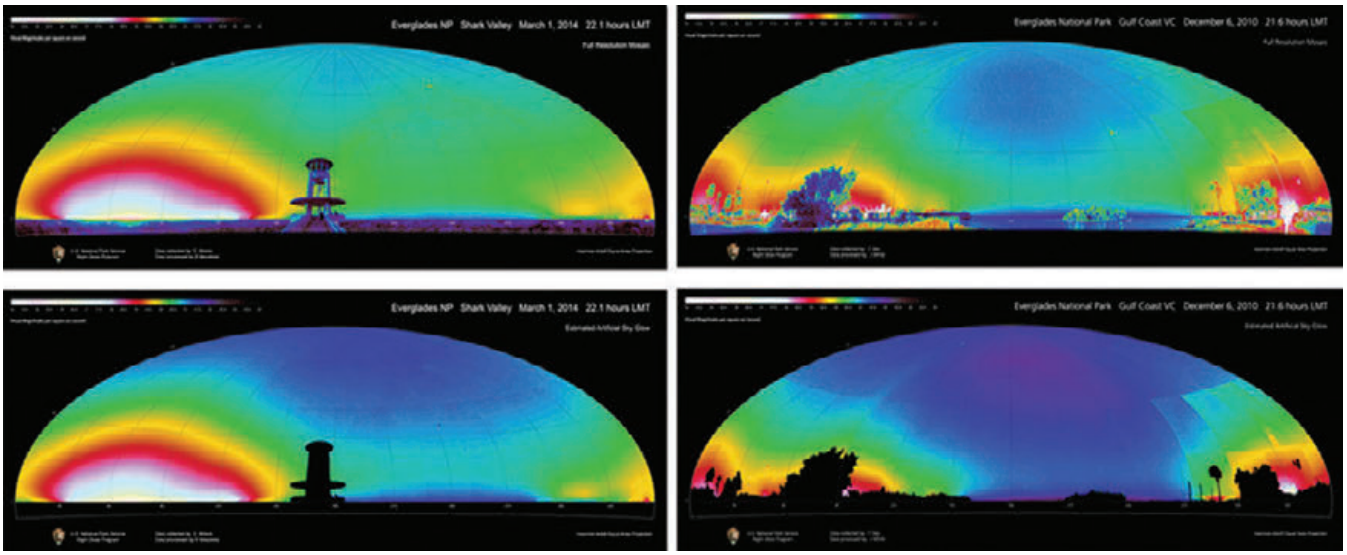

Figure 40. Observed (top left and top right) and estimated (bottom left and bottom right) artificial sky brightness mosaics at Shark Valley (left) and Gulf Coast VC (right).

NPS Photo, J. Gamble

SOLITUDE OR PRIMITIVE AND UNCONFINED RECREATION QUALITY

Indicator: Facilities that decrease self-reliant recreation

This indicator focuses on the presence of facilities in wilderness that decrease opportunities for self-reliant recreation. These facilities make it possible for individuals traveling in nonmotorized craft to make extended overnight trips and experience the vast wilderness resource; however, these facilities may adversely affect opportunities for a primitive and unconfined type of recreation.

Number of Authorized Constructed or Improved Recreation Features

Measure Baseline Data Value: 120 (1981)

Current Data Value: 60 (2021)

Definitions:

- No definitions provided.

Background and Context:

The National Park Service installs and maintains recreation features within wilderness areas for the health and safety of wilderness users and preservation of wilderness resources and values. However, these features impact wilderness character by reducing the need for primitive skills and self-reliance. Additionally, these recreation features are readily visible as clear signs of human use. Many, but not all, of these recreation features are classified as "facilities" in FMSS.

A variety of recreation features are located in the MSD Wilderness and other lands managed as wilderness at Everglades National Park, with a majority consisting of marked paddling trails, chickees, campsites, toilets, and markers or signs (Figure 41). Navigational markers are a common development along paddling trails due to visitor safety, as one can become easily lost paddling within mangrove forests. Although these markers aid in visitor safety, they reduce the need for self-reliance and personal skill development.

Figure 41. Campsite sign at Tiger Key.

Chickees are another common recreation feature in the wilderness (Figure 42). Chickees are elevated wooden platform campsites over water. These backcountry campsites offer a dry place out of the water to sleep or rest. Chickees are common because ground campsites and beaches are limited in the MSD Wilderness and other lands managed as wilderness at Everglades National Park, and they provide resource protection as camping inside mangrove trees and on tree islands can have large and lasting impacts to these sensitive habitats. However, chickees also reduce the degree of skill and self-reliance needed to camp in the MSD Wilderness and other lands managed as wilderness at Everglades National Park.

Figure 42. Plate Creek chickee.

Measure Description and Collection Protocol:

This measure assesses the total number of authorized constructed or improved recreation features.

The first step is to ensure users understand what types of recreation features are counted under this measure and compile data. This measure counts authorized constructed recreation features located within wilderness, such as trails, campsites, toilets, fire grates, interpretive signs, and trash cans. General guidelines for what features to include and exclude from this measure are described below.

- This measure records authorized features (i.e., installed and maintained by the National Park Service, or historical structures used by visitors). It may also include user-created structures (e.g., tent pads or outfitter camp structures) that managers maintain or permit to exist, but it does not include unauthorized user-created features that are routinely removed when found.
- To avoid double counting, non-recreational developments are not counted under this measure because they are monitored for the measure *Index of Authorized Non-Recreational Physical Development under the Undeveloped Quality*.
- Designated hiking trails and marked paddling trails are included in this measure, but individual markers that delineate a trail are considered part of the trail and not counted separately.
- Several types of trail-related features (e.g., trail turnpikes, trail signs, or blazes) are not included because they may have minimal impact on the sense of primitive recreation (relative to major facilities).
- Designated ground and beach campsites are not counted as part of this measure because the designation in and of itself does not constitute a development. However, recreation features associated with designated campsites (e.g., toilets, fire grates, interpretive signs, trash cans) are counted. Chickees are counted because they are man-made developments.

The following is a general list of features that should be included:

- shelters, including chickees
- toilets and toilet buildings
- tent pads or tent platforms (fabricated with wood, cement, or other material and designed to be permanent installations)
- docks at ground or beach sites
- picnic tables
- benches
- permanent fire rings, grills, fireplaces, or wood stoves
- campsite signage (e.g., campsite markers, regulation signage)
- trash cans
- any other feature that reduces the self-reliance of wilderness visitors

Each feature included in this measure is weighted equally, and all recreation features at a site are counted separately. For example, a toilet and a fire ring at one site are counted as two features. Likewise, a picnic table on a chickee would count as two features. A double chickee is counted as two features, as it expands the capacity for the park to accommodate campers at those

sites and therefore reduces their need for self-reliance and skills in wilderness travel. Sum the total number of recreation features to derive the measure value.

Data Source:

- 1981 Backcountry Management Plan
- Facility Management Software System
- GIS Specialists
- The 'Wilderness Trip Planner'

Data Adequacy:

Medium—The data quantity is complete since all features are included in FMSS or GIS databases. The data quality is good because the maintenance division keeps current information on known recreational features and report locations and new features.

Frequency:

Every five years.

Meaningful Change:

The threshold for meaningful change is any change in the total number of authorized constructed or improved recreation features. A decrease in the number of features beyond the threshold for meaningful change results in an improving trend in this measure.

NPS Photo

NPS Photo, D. Diaz

SOLITUDE OR PRIMITIVE AND UNCONFINED RECREATION QUALITY

Indicator: Management restrictions on visitor behavior

This indicator addresses National Park Service restrictions on visitor behavior in wilderness, encompassing formally adopted regulations or policies that govern visitor behavior, travel, or equipment. Restrictions may be national, regional, or local in scope, and may apply to the entire wilderness or just certain areas within a wilderness.

Index of Visitor Use Management Restrictions

Measure Baseline Data Value: 24 (1988)

Current Data Value: 23 (2020)

Definitions:

- No definitions provided.

Background and Context:

Opportunities for solitude or primitive and unconfined recreation are written into the Wilderness Act as a key component of wilderness. However, at times providing for unrestricted visitor use can also compromise other wilderness resources and values. Unrestrained visitors may heavily and repetitively impact vegetation which may lead to soil erosion and alter species composition leading to an impact to the Natural Quality. Additionally, an absence of visitor restriction may even degrade the Solitude or Unconfined Recreation Quality if for example a plethora of visitors want to visit one particular unique location in the park. Use and behavior restrictions are important tools used by park managers to achieve a balance between visitor use and natural or cultural resource protection.

Although visitor use restrictions occur, visitors looking for adventure, self-reliant recreation, and primitive experiences can easily find it. The MSD Wilderness and other lands managed as wilderness at Everglades National Park are unique in that visitors are not required to stay on any trails or in any campsites for that matter. The destination of a visitor is left to a visitor.

However, there are regulations in place to protect sensitive habitats such as area closures and human waste disposal requirements. Continued reassessment of the effectiveness, relevance, and enforceability of these visitor use restrictions is important as the number and nature of wilderness visits change and as park management strives to preserve the Primitive or Unconfined Recreation while preserving other wilderness qualities.

Measure Description and Collection Protocol:

The data value for this measure is the sum total of the weighted scores for regulations related to visitor use that exist in wilderness areas. Existing regulations to visitor use recreation that apply to wilderness areas are identified in the Superintendent's Compendium. These individual regulations are categorized by themes, (i.e., campfires, camping, and permits) existing in the regulation documents and are identified in Table 22 under 'Category'. Each regulation is given a 'Severity Score' based on the current type of regulation. These 'Types of Regulations' and associated 'Severity Scores' are also outlined in Table 22. If no regulation or restriction exists, the severity score would be zero for that particular category. The categories and scoring have been adapted from a similar measure in the draft NPS "Wilderness Character Monitoring Technical Guide" (n.d.). A lower severity score is associated with little to no regulation, while a higher severity score is associated with higher regulation such as total prohibition. If there are multiple regulations under a single category, the regulation with the highest severity score is used. It should be noted that this measure addresses most, but not all, of the resource protection and public use and recreation regulations in the Superintendent's Compendium for the sake of brevity and feasibility.

Once the severity scores for the selected regulations are determined, each regulation is weighted by the geographical extent of the regulation as outlined in Table 23. If a regulation only applies to a sub-area of the wilderness, it receives a weight of 1. If a regulation applies to the entire wilderness, it receives a weight of 2. The 'Severity Score' is multiplied by the 'Weight of Geographical Extent' for a 'Total Regulation Score' for each regulation. The data value is the sum of all total regulation scores calculated for this measure.

A decrease in the number of visitor use management restrictions contributes to an upward trend in this indicator and benefits the Solitude or Primitive and Unconfined Recreation Quality.

Table 22. Severity Score for Visitor Use Restriction

Category	Severity Score	Type of Regulation
Campfires	1	Some restriction
Campfires	2	Total prohibition
Camping	1	Mandatory setback or other general regulation
Camping	2	Designated site
Camping	3	Total prohibition
Permits	1	Permit required for overnight use
Permits	2	Permit required for day use
Permits	3	Permit required for both overnight use and day use
Length of Stay	1	Length of stay limited
Area Closure	1	Area closed seasonally or temporarily
Area Closure	2	Area closed year-round

Category	Severity Score	Type of Regulation
Group Size Limit	1	Overnight group size limit
Group Size Limit	2	Day use group size limit
Domesticated Animals	1	Required to be leashed
Domesticated Animals	2	Total prohibition
Horses and Pack Animals	1	Limitations exist
Horses and Pack Animals	2	Total prohibition
Fishing	1	Restrictions in addition to state laws
Fishing	2	Total prohibition
Collecting / Foraging	1	Restrictions in addition to 36 CFR and/or state laws
Collecting / Foraging	2	Total prohibition
Food Storage	1	Requirements exist
Food Storage	2	Total prohibition
Human Waste	1	Proper burial or use of toilet facilities required
Human Waste	2	Pack out required
Trails & Travel	1	Cutting the trail (switchbacks) prohibited
Trails & Travel	2	Off-trail travel is prohibited
Swimming & Wading	1	Limitations exist
Swimming & Wading	2	Total prohibition

Table 23. Weight of Geographical Extent

Score	Description
1	Regulation applies to only a sub-area of wilderness
2	Regulation applies to the entire wilderness

Data Source:

- Superintendent's Compendium
- Everglades Fishing Regulations guide

Data Adequacy:

High—Data quantity is complete because visitor use restrictions are clearly defined in park policy. Data quality is also good because visitor use restrictions are clearly defined in park policy. See Table 24.

Frequency:

Every five years.

Meaningful Change:

The threshold for meaningful change is any change in the measure value. A decrease in the measure value beyond the threshold for meaningful change results in an improving trend in this measure.

Table 24. Index of Visitor Use Management Restrictions for 2020

Type	Specifics	Severity Score	Weight of Extent	Total
Campfires	Ground fires permitted below the high tide line at designated beach campsites.	1	2	2
Camping	Setbacks for camping on boat when not at designated sites.	1	1	1
Permits	Permit required to camp overnight in the backcountry with few exceptions.	1	2	2
Length of Stay	30-day limitation overall. 14-day limitation Nov 1–April 30.	1	2	2
Area Closures	Many places listed for total prohibition and seasonal closures	2	1	2
Group Size	Group size is limited for overnight use of chickees and ground sites.	1	1	1
Domesticated Animals	Pets prohibited in terrestrial wilderness; allowed on boats.	2	1	2
Horses and Pack Animals	Stock only permitted in designated areas.	1	2	2
Fishing	Prohibited gear, bait, type of fish, and location are more restrictive than State regulations. Area closures exist.	1	2	2
Collecting / Foraging	Collecting of dead wood is permitted	1	2	2
Food Storage	Food storage regulations (36 CRF § 2.10[d]) apply to vessels operating in undeveloped areas.	1	1	1
Human Waste	Human waste must be buried at least 6 inches (36 CRF § 2.14[a][9])	1	2	2
Trails & Travel	No restrictions.	0	0	0
Swimming & Wading	Prohibited in all canals, ponds, freshwater lakes, marked channels, boat basins, and within 100 ft. of a shoreline closed to landing.	2	1	2
Data Value Total	–	–	–	23

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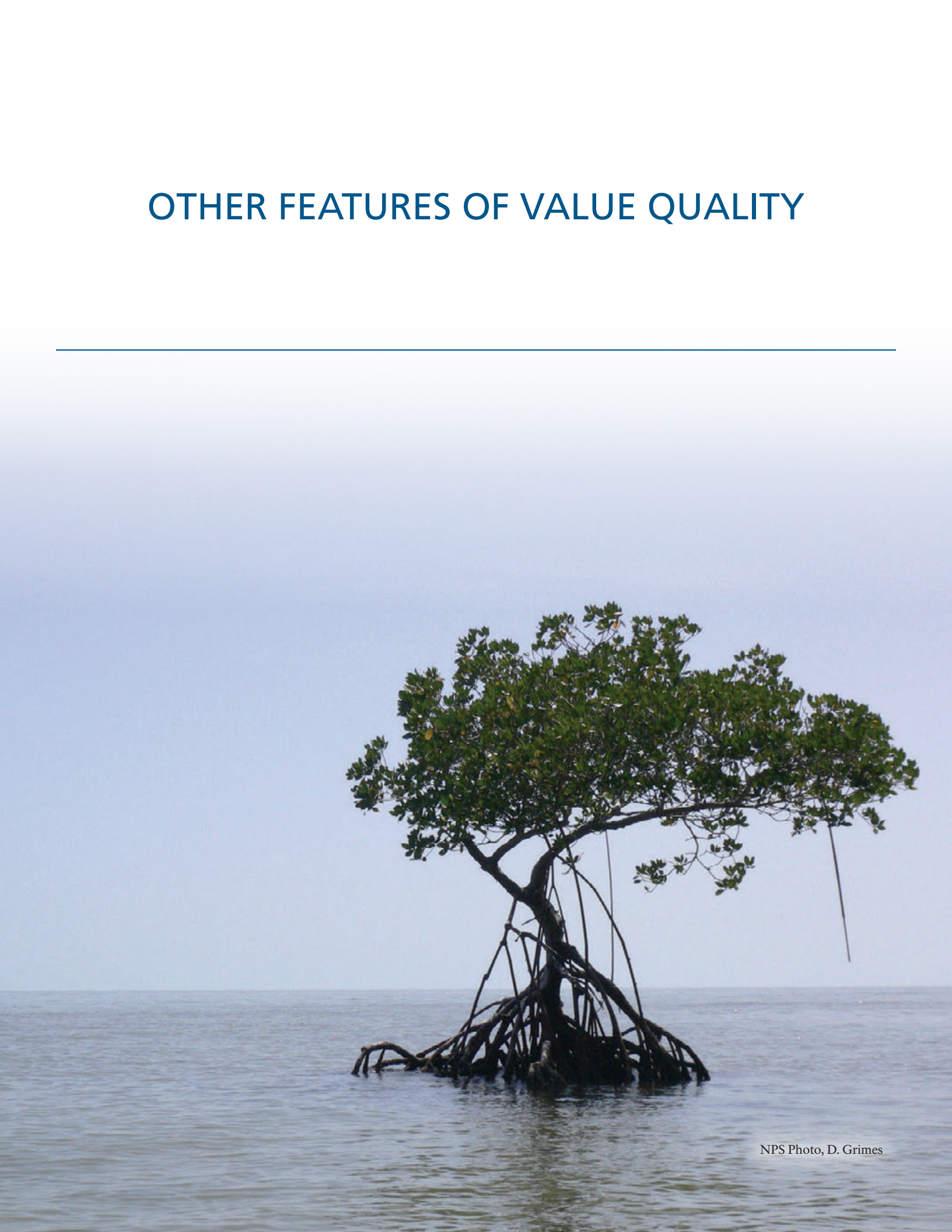
OTHER FEATURES OF VALUE QUALITY



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OTHER FEATURES OF VALUE QUALITY

Wilderness may also contain other tangible features of scientific, educational, scenic, or historical value.

The objective of monitoring the Other Features of Value Quality is to assess how the condition of important features of historical, geologic, scenic, and educational value that are integral to wilderness character are changing. This monitoring focuses on cultural features and other features of value determined to be integral to wilderness character.

Section 2(c) of the Wilderness Act defines wilderness as an area that "may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value." Including such features, if they exist and play an integral role to defining the meaning and value of the area as wilderness, can provide a more complete picture of wilderness character. Monitoring this quality focuses on specific, tangible features and how the conditions of these features change over time; it does not monitor the values derived from these features. By protecting the physical condition of the features, the values associated with them are likely preserved. The primary challenge with this quality lies in determining which features, if any, are integral to the character of a particular wilderness.

Features to include may:

- Be specifically identified in the enabling legislation for the wilderness, be on the National Register of Historic Places, on a State Register, or part of a National Historic Trail, be identified as a Priority Heritage Asset, or be specifically identified in the park foundation document;
- Contribute to making the area's meaning and significance clear and distinct, or help define how people think about and value an area;
- Help tell a broader story of a distinctive human relationship with the land; and/or
- Contain additional educational, scientific, or scenic value.

Even if a feature fits in one or more of the above categories, it may not necessarily be considered under this quality. The intent is to include only those features that have wilderness significance and enhance the story of the wilderness. Ultimately, it is up to local resource specialists and wilderness managers to determine if any other features of value are present and should be included in wilderness character monitoring.

Table 25 shows all measures selected to monitor the Other Features of Value Quality in the MSD Wilderness and other lands managed as wilderness at Everglades National Park. The measures are described in detail below.

Table 25. Measures Selected for the Other Features of Value Quality

Indicator	Measure	Frequency in Years	Data Adequacy	Meaningful Change	Baseline Data Value (year)	Current Data Value (year)
Deterioration or loss of integral cultural features	Number of shell works that have received a "poor" condition assessment since wilderness designation	5	Low	Any Change	0 (1978)	4 (1978–2019)

A single monitoring question is used in monitoring the Other Features of Value Quality: What are the trends in the unique features that are tangible and integral to wilderness character?

The monitoring question is intended to address the trend in the condition of specific, tangible features that are integral to wilderness character (i.e., those features that define the meaning and significance of the area). Features included in this quality are, by definition, truly integral to wilderness character; therefore, damage, disturbance, or decline to any feature assessed under this quality should always be interpreted as degrading wilderness character.

While it is anticipated that the trends in measures in this quality may often be stable or degrading, projects to improve the condition of features (e.g., successfully removing graffiti from an integral natural feature) could lead to an improving trend in this quality.

To address this monitoring question, up to two indicators may be used if features are present: (1) deterioration or loss of integral cultural features, and (2) deterioration or loss of other integral site-specific features of value). For the purposes of this wilderness character baseline assessment, only the first indicator is utilized.

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NPS Photo, G. Eseverri

OTHER FEATURES OF VALUE QUALITY

Indicator: Deterioration or loss of integral cultural features

This indicator captures the trend in the condition of specific, tangible cultural features that are integral to wilderness character (i.e., those features that define the meaning and significance of the area). Cultural is defined broadly to include both prehistoric and historical features. Only those features determined to be integral to wilderness character are included in this monitoring. A decline in the condition of cultural features is viewed as degrading wilderness character.

Number of Shell Works That Have Received a "Poor" Condition Assessment Since Wilderness Designation

Measure Baseline Data Value: 0 (1978)

Current Data Value: 4 (1978–2019)

Definitions:

- No definitions provided.

Background and Context:

Archeological sites give important insights to cultures past. Archeological sites provide an important intellectual knowledge that help to better understand where we as humans came from, and these cultural resources may inform decisions in the future.

Archeology is also a great education tool, fostering a more intellectual community and inspiring endless questions. Archeology can play a direct role in local communities by telling the story of historic districts or supporting the local economy (Smith & Harris n.d.). Humans and human history are one component of nature. These cultural resources are an integral part of wilderness character and contribute positively to preserving Wilderness (Cowley et al. 2012).

One unique archeological feature in the MSD Wilderness and other lands managed as wilderness at Everglades National Park is shell works. These sites are "some of the largest and most complicated prehistoric shell constructions in the world" (Schwadron 2010). Shell works are complex sites consisting of ridges, mounds, platforms, and courtyards reflecting a unique maritime hunter-gatherer tradition (Schwadron 2010). Their exact social uses are unknown, but it is likely that they were used to divide gathering places from sacred spaces and provide barriers from mosquitoes or ocean tides (NPS n.d.). The large-scale formations suggest that organization and social planning occurred for construction. Shell works, artifacts, and features in the MSD Wilderness and other lands managed as wilderness at Everglades National Park show a history of human habitation from the late archaic to the 16th century. Several tribes occupied the area including the Calusa tribe said to be the most prevalent by Spanish settlers. The Calusa occupied a large area of the southwest coast of Florida from Lake Okeechobee down to Cape Sable. The Calusa were organized by Chiefdoms and were composed of small villages that each contained a chief according to archeologists. Many of these villages were located along the 10,000 islands in the MSD Wilderness (NPS n.d.).

Threats to shell works include weathering, vandalism, sea level rise, and park management actions.

Measure Description and Collection Protocol:

The data value is the total number of individual shell works and shell middens that have received a "poor" condition assessment since wilderness designation. This data value is derived from the Cultural Resources Inventory System (CRIS). The location of shell works is not reported. Consult with local archeologists for updated conditions of shell works. Evidence of human impact, (i.e., ground disturbance and looting) should be documented and reflected in the condition of shell works for this measure. Shell works that have been assessed as "poor" in the past but have a more recent assessment of "fair" or "good" still count towards the data value. A subsequent "poor" assessment for a site that has already received a "poor" assessment is not counted a second time. An increase in the total number of shell works and shell middens that have received a "poor" condition assessment since wilderness designation contributes to a downward trend in this indicator and impacts the Other Features of Value Quality.

Very little of the MSD Wilderness has been inventoried for cultural resources. As of August 2021, 39 shell works have been assessed. The current data value reflects known information and is not reflective of the entire wilderness. As new sites are discovered and as the wilderness significance of known sites is further evaluated, additional features may be incorporated into this measure, and documented accordingly.

Data Source:

- Cultural Resources Inventory System (CRIS)
- Archeologist, Everglades National Park

Data Adequacy:

Low—The data quantity is insufficient because the park has not fully and sufficiently been surveyed for cultural resources. The data quality is moderate because some of the known sites that have been surveyed are dated.

Frequency:

Every five years.

Meaningful Change:

Any change in the total number of shell works sites that have received a "poor" condition assessment is a meaningful change.

MEASURES NOT USED FOR WILDERNESS CHARACTER MONITORING

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MEASURES NOT USED FOR WILDERNESS CHARACTER MONITORING

The measures described below were considered as measures for wilderness character monitoring but were ultimately not used. Descriptions of each measure and the rationales for exclusion are included in this section under the relevant indicator.

UNTRAMMELED QUALITY

Indicator: Actions authorized by the federal land manager that intentionally manipulate the biophysical environment

Initially, four separate measures were identified for the Untrammeled Quality, each targeting specific programs or activities. While each of these is important to include in a measure for the Untrammeled Quality, there are a few pitfalls with monitoring them independently through multiple measures. First, by having targeted measures for specific programs or activities, trammeling actions that fall outside the scope of those measures would go uncounted. Secondly, and perhaps more importantly, an inherent problem exists with the rollup process when multiple measures that count trammeling actions are selected that could result in a disingenuous and inaccurate trend for the represented indicator.

Indicator	Measure	Baseline Value	Current Value	Change	Trend of Measure	Trend for Indicator
Authoritized Trammeling Actions	Measure 1	5	25	20	↓	↑
	Measure 2	10	8	-2	↑	
	Measure 3	6	3	-3	↑	
Net Change = 15						

Figure 43. Example set of measures using three separate monitoring measures to calculate authorized trammeling, which exposes the inherent problem with rolling up untrammeled measures in this manner.

As seen in the example set of measures in Figure 43. Example set of measures using three separate monitoring measures to calculate authorized trammeling, which exposes the inherent problem with rolling up untrammeled measures in this manner, Measure 1 has a relatively large increase which indicates a downward trend for the measure. However, Measures 2 and 3 show slight decreases, which indicates an upward trend for both measures. While the rollup for the indicator shows an improving trend (i.e., decrease in the amount of authorized trammeling), there would be a net increase in the overall number of authorized trammeling actions. Per *Keeping It Wild 2*, all trammeling actions should be counted equally regardless of the magnitude of their effects. As such, counting trammeling actions in this manner would be disingenuous and would not capture the true status of the indicator. For these reasons, a single measure that aggregates all types of authorized trammeling, including actions that intentionally manipulate nonnative species, was chosen to accurately identify a trend for the indicator.

Therefore, data that would have been used for these measures was incorporated into a singular chosen measure for the represented indicator. The four separate measures considered are described in further detail below.

Measure: Number of actions that intentionally manipulate nonnative species

Actions that manipulate plants and animals, such as the control of nonnative species, are sometimes necessary to preserve healthy ecosystems. Nonnative species introduction can cause dramatic changes in an ecosystem by outcompeting native species, causing native species extinction and altering species composition (Jeschke et al. 2014). The National Park Service is currently involved in national programs to protect parks from the negative impacts of nonnative species; however, a decision to actively manage for nonnative species in wilderness areas impacts the Untrammeled Quality and overall wilderness character.

Measure: Number of actions and persistent structures that manipulate hydrologic resources

The MSD Wilderness and its hydrologic resources have a complicated past. As a result of past water drainage, the Everglades ecosystem was heavily impacted. Consequently, a large-scale restoration project began in the 1980s called the Everglades Restoration Project and continues as part of the Comprehensive Everglades Restoration Plan (CERP). Actions and persistent structures that manipulate the hydrologic resources in the MSD Wilderness, such as water flow quantity prescriptions via inflow stations, are necessary to simulate natural conditions and preserve the Natural Quality. Although these actions have been required by law at the state and federal level, these actions are still trammeling and degrade the Untrammeled Quality.

Measure: Number of natural wildfires that receive a suppression response

Fire is a natural and critical part of the Everglades ecosystem. Before heavy human management, nonanthropogenic fires burned freely, shaping the landscape and leaving lasting impacts. Some ecosystems evolved with regular fire cycles, and many plants and animals are dependent on the presence of fire. When managing fire, park managers must consider overall safety, physical developments, critical habitats, and adjacent urban areas, making the use of suppression an effective management tool. However, the suppression of wildfire from naturally ignited fires is a trammeling action because the action alters and manipulates a natural course of the environment.

Measure: Number of prescribed burns

Prescribed burning and fuel reduction projects allow resource managers to reduce fire danger, mitigate the risk of escaped wildfires, and establish desired vegetation and fire regimes. Prescribed fires often attempt to mimic the role a natural fire would have in an ecosystem, thinning ground cover, removing dead and downed vegetation, and reducing overall fuel accumulation. Prescribed fire in the MSD Wilderness and other areas managed as wilderness at Everglades National Park has occurred since the wilderness was federally designated. Prescribed fires help restore and maintain the wet prairies and sawgrass marshes located throughout the wilderness areas. These landscape-scale prescribed burning projects are necessary because natural historic fire spread is limited due to anthropogenic development and habitat fragmentation.

Indicator: Actions not authorized by the federal land manager that intentionally manipulate the biophysical environment

Measure: Number of documented incidents involving boat groundings or damage to submerged wilderness resources

A measure that uses "number of documented incidents" does not accurately reflect human impact trends over time. Rather, these documented incidents reflect available resources for law enforcement personal who would report the incidents, and these reports are dependent on funding and available time to dedicate to a particular location. Additionally, it would be difficult to determine whether a boat grounding was an intentional trammeling action. The shallow waters of Florida Bay, right above the MSD Wilderness where many boat groundings occur, can be difficult to navigate, especially for inexperienced boat drivers. Lastly, the importance of boat groundings is in its relationship to negative impacts within the seagrass and seagrass communities. The impact to this benthic environment is captured in the Natural Quality with the "total length of propeller scarring of seagrass in Florida Bay" measure.

Measure: Number of unauthorized actions and persistent installations that manipulate plants, animals, pathogens, soil, water, and fire

This measure speaks directly to the indicator by counting all significant actions that have not been authorized and/or supported by the managing park unit that intentionally manipulate the biophysical environment. It does not parse trammeling actions based on source or intensity and counts all trammeling actions equally under a single measure. Unauthorized actions that occur outside of wilderness with the explicit intent of manipulating the biophysical environment within wilderness count as trammeling actions. For this wilderness character baseline assessment, this measure was excluded because obtaining accurate and reliable data to address this indicator is extremely challenging. It is difficult to determine from law enforcement data if offenses were in fact (1) trammeling types of actions and (2) intended to manipulate the biophysical environment. In addition, the ambiguity of this data detracts from the more reliable authorized trammeling indicator when the trends from each indicator are rolled up to determine an overall trend for the untrammeled quality. In the future, park staff may integrate this indicator if and when more reliable data is available.

NATURAL QUALITY

Indicator: Ecological processes

Measure: Number of algal bloom events per year linked to anthropogenic events

The relationship of human influence on algal blooms is important, as algal blooms can negatively impact marine ecosystems. The development of an algal bloom is likely a result of a complex and dynamic combination of human and environmental factors, including nutrients, temperature, sunlight, ecosystem disturbance, hydrology, and water chemistry. However, the combinations of events that trigger an algal boom are not well understood and it is difficult to attribute just one factor to any specific algal bloom. One attribute that humans can and do contribute to with respect to algal blooms is the change in nutrients that may contribute to an algal bloom event. Nutrients such as phosphorus runoff from neighboring agricultural fields may contribute to such events and this nutrient is monitored in another measurement of wilderness character under the Natural Quality. For these reasons, the number of algal bloom events per year was not selected as an indicator for ecological processes.

Indicator: Animals

Measure: Percentage of sport fish landed above spawning potential length

Sport fish documentation is important as it provides information about overall marine health. The presence of sport fish above spawning potential length is an indication of the health and population of smaller fish and animals lower in the food chain. Additionally, Everglades National Park conducts yearly creel surveys dating back to the 1970s in which anglers can volunteer their catch information to park staff. However, information on sport fish landings does not directly answer the monitoring question, "What are the trends in the natural environment from human-caused change." Currently, the relationship between direct human impact and the marine fish communities is not clear in Florida Bay. Fish populations natural fluctuate for a variety of

reasons. Lastly, the creel surveys are not an accurate or reliable source of data as data is voluntary and not validated. For these reasons, this proposed measure was not selected as an indicator for animals.

Measure: Index of priority nonnative animal species

Nonnative animal species can impact and alter the environment in a number of ways, including preying on native species, outcompeting native species for food and resources, aiding in the spread of disease, and preventing the reproduction of native species. In the MSD Wilderness and other park lands managed as wilderness, two nonnative species were initially identified as having a large and lasting impact on the Natural Quality and the overall wilderness character: Burmese python and feral pigs. This measure was considered a compliment to the measure "Index of priority nonnative plant species." However, the management of nonnative animals is not approached in the same manner as plants. While the identification of priority nonnative plants is well established, there is ongoing debate among park staff on which nonnative animals beyond the Burmese python should receive management priority. More importantly, the data needed for consideration as a measure was lacking, and therefore this measure was eliminated from further consideration.

Measure: Rate of new nonnative herpetofaunal introductions

The invasion of Florida by nonnative herpetofauna is severe, particularly in southern Florida both in and around the Everglades ecosystem. Prevention and early detection are key strategies in combating this persistent threat. However, efforts to manage invasive herpetofauna are hampered by the continued introduction of new reptile and amphibian species. In order to preserve and improve upon the Natural Quality, the rate of new introductions must first be greatly reduced with the goal of eliminating new arrivals altogether. This measure was intended to use information included in the Everglades National Park 2013 Indicators of Integrity report, which was developed in response to reporting requirements of the World Heritage Committee. However, after speaking with Bryan Falk, the invasive species biologist for Everglades National Park, it was determined that ongoing data collection to support the measure would be insufficient and unable to accurately identify trends going forward. Therefore, this measure was abandoned in favor of the measure for "presence of nonnative fishes," which incorporates a more reliable data source.

Indicator: Ecological processes

Measure: Slough Vegetation Performance Measure

Before the substantial drainage and compartmentalization of the Florida Everglades that began in the late 1800s, the ridge and slough habitat—so called because the sawgrass ridges were approximately 30–90 centimeters (1–3 feet) higher than the adjacent sloughs—was the most expansive landscape in this wetland ecosystem. Today, the estimated elevation difference between ridges and sloughs in Shark River Slough, located within the MSD Wilderness, is only 10 centimeters (0.3 feet). Over the years, the loss and degradation of the ridge and slough landscape had cascading impacts on the aquatic productivity of the Everglades ecosystem that ultimately impacted higher-level trophic consumers (Lo Galbo et al. 2013). While distinct physiochemical and plant assemblage differences still distinguish Everglades ridges from sloughs today, slough degradation is characterized by changes in plant species composition and physical degradation of the ridge and slough topography. As a predictive tool, a slough vegetation performance measure was developed to simulate the effects of past, current, and future hydrological conditions on the native Everglades slough plant community (Lo Galbo et al. 2013). This same tool could be used to compare past and current conditions in order to establish a trend in the overall health of the ridge and slough ecosystem within the MSD Wilderness and other areas managed as wilderness at Everglades National Park. This measure was considered to monitor the recovery of ridge and slough habitat, which encompasses a large portion of the wilderness, from past impacts, and identify trends in its progression towards historical conditions. However, there are a few concerns with using the performance measure for wilderness character monitoring. First, use of the model is complex and therefore difficult to replicate. Secondly, although historical conditions were anthropogenically altered, the use of this measure

implies that the wilderness should be maintained in a specific condition and the preservation of an unchanging past. Wilderness character allows ecological systems to evolve and should not maintain a targeted ecological status quo or desired set of conditions (Landres et al. 2015).

Indicator: Ecological processes

Measure: Mean sea level rise

Scientists have established that humans contribute large amounts of carbon dioxide and methane into the atmosphere and that these gases are affecting the climate. One result of climate change is sea level rise. Sea level rise poses a threat to the park due to its proximity to the ocean. Mean sea level rise is an important phenomenon that may play a major role in future park management and decision making. However, sea level has a natural variation on a grand scale. Trends in sea level rise cannot be assigned a trend without referencing an "ideal sea level" or implying the preservation of an unchanging past (Landres et al. 2015).

Measure: Index of animal/plant species of management concern

Wilderness encompasses variability and change. The goal of wilderness and wilderness character is to allow ecological systems to evolve and change over time, and it should not maintain a targeted status quo or desired set of conditions (Landres et al. 2015). Monitoring rare and endangered species is complex in the Everglades, and impact to these species is variable and is not easily tied directly to human change and impact.

Indicator: Air and water

Measure: Concentrations of total phosphorus at inflow stations

The MSD Wilderness and other lands managed as wilderness at Everglades National Park are excellent examples of low nutrient systems that are highly sensitive to increased phosphorus levels. Increased phosphorus levels are especially likely because Everglades National Park is adjacent to and downstream of large agricultural lands. As such, phosphorus is currently removed from the water by means of stormwater treatment areas located south of Lake Okeechobee (north of the park), and phosphorus levels at inflow stations to the park are closely monitored. It is crucial to monitor phosphorus before it enters the park to gain a better understanding of potential phosphorus impacts inside the park. This measure would monitor a potential threat to the natural quality from an anthropocentric source and was initially considered for inclusion in this assessment. However, after speaking with subject matter experts at the park, it became clear that much of the phosphorus that passed the inflow stations would settle near those stations soon after entering the park. Therefore, this measure would only evaluate impacts along the periphery of the wilderness boundary and would not be representative of the larger wilderness. In response, a new measure was developed that incorporated phosphorus data collected from periphyton. This sampling was distributed within the park and thus is more representative of the wilderness.

Measure: Total annual water flow at Shark and Taylor Slough

The total amount of water that flows through each slough as well as the distribution of this water has a large impact on Everglades Ecosystem. The amount of water and its distribution impacts all aspects of the environment including wildlife (especially wading bird populations), plant distribution (particularly tree island shape and function), and hydrologic functions (freshwater and saltwater relationship). The water flow is highly regulated and managed by humans; consequently, the water regulations effects on the Everglades are heavily studied and monitored by experts. These efforts cannot be replicated in one measure for wilderness character. Additionally, wilderness allows for dynamic processes to occur such as variation in water flow. As previously discussed, wilderness should not maintain a targeted status quo or desired set of conditions. Therefore, this measure was not selected.

UNDEVELOPED QUALITY

Indicator: Use of motor vehicles, motorized equipment, or mechanical transport

Measure: Index of unauthorized use of mechanical transport, motorized vehicles, or motorized equipment

Unauthorized use of mechanical transport, motorized vehicles, or motorized equipment does occur in the MSD Wilderness and other lands managed as wilderness at Everglades National Park, such as ATV and airboat use. However, documented incidents of unauthorized use by the public are limited, as reporting relies on funding and dedicated time to patrolling and may not reflect the true number of occurrences. In the future, the measure for authorized use of motor vehicles, motorized equipment, or mechanical transport may be expanded to include unauthorized use if the park staff feels appropriate.

Measure: Number of events of motorboat or airboat entering wilderness per year

This measure seeks to monitor the prohibited uses of motorboat and airboat in wilderness areas. Additionally, there are many other motorized vehicle and mechanical transport uses in wilderness. This measure was rolled up into another measure under the Undeveloped Quality labeled, "index of authorized use of mechanical transport and motorized vehicle use."

Measure: Number of helicopter landings

Listed under the section, "Prohibition of Certain Uses" in the Wilderness Act, this measure states that there shall be "no landing of aircraft" in wilderness areas. While use and landing of aircraft may be necessary in situations such as emergency incidents, law enforcement, fire suppression, and research, aircraft touchdowns still degrade wilderness character and the Undeveloped Quality. The lack of solid dry land within the MSD Wilderness and other lands managed as wilderness at Everglades National Park often makes aircraft the preferred method of transportation into wilderness areas. With the presence of large-scale restoration and research efforts, many existing projects require the use of helicopter to get work done efficiently and effectively. However, aircraft landings may be the single largest impact to the Undeveloped Quality for the MSD Wilderness and other lands managed as wilderness at Everglades National Park, which is why this measure was initially considered. After evaluating potential data sources, it became clear that landing data was largely inconsistent or nonexistent. In order to simplify data collection and improve accuracy, the decision was made to count the number of days in which a helicopter landing occurs as opposed to counting individual landings. Helicopter landings were incorporated into the measure "index of authorized use of motor vehicles, motorized equipment, and mechanical transport" to comprehensively monitor impacts from access and field activities.

Indicator: Presence of nonrecreational structures, installations, and developments

Measure: Miles of road

Wilderness encompasses places that are substantially free of permanent improvements, as wilderness is a land that retains its primeval character and influence. The Wilderness Act explicitly states that there shall be no permanent roads within any wilderness area. The MSD Wilderness and other lands managed as wilderness at Everglades National Park are without any permanent roads; however, temporary roads exist and act as fire breaks to conduct prescribed burning projects, law enforcement patrol routes, access corridors to perform invasive species treatment, and access corridors to collect a variety of research data. These temporary roads aid in a variety of ongoing park projects whose outcomes provide benefits to the Natural Quality; however, roads of any kind still diminish the Undeveloped Quality, as a road is a clear sign of human occupation and can lead to further developments in the future. While the impact of roads within wilderness is clear, their impact is similar to other nonrecreational physical development. Therefore, instead of monitoring them as a stand-alone measure, the decision was made to incorporate miles of road into a single measure that monitors nonrecreational physical developments.

SOLITUDE OR PRIMITIVE AND UNCONFINED RECREATION QUALITY

Indicator: Remoteness from sights and sounds of human activity inside wilderness

Measure: Percent of noise-free soundscapes

The Wilderness Act contains both implied and stated terminology that supports protecting soundscapes in wilderness areas. The ability to enjoy quietness and sounds of nature apart from anthropogenic noise is a vital component of wilderness solitude. Noise and anthropogenic sound can affect many of the intangible, spiritual, and self-reflective values of wilderness that visitors seek. Most anthropogenic sounds in the MSD Wilderness and other lands managed as wilderness at Everglades National Park come from motorboats, airboats, and aircraft. While conceptually, this measure would evaluate an important aspect of wilderness character, data collection would require regularly scheduled visits by the NPS Natural Sounds and Night Skies Division (NSNSD) to facilitate monitoring. While scheduled visits could be attempted, there was some uncertainty as to how reliably this could be done. Furthermore, the potential baseline data that was collected from 2008–2009 included five locations within Everglades National Park, only two of which were in wilderness. To simplify the measure, the decision was made to rely on readily available GIS data referenced in the "acres of wilderness away from access and travel routes and developments inside wilderness" measure to represent potential impacts from sights and sounds within wilderness.

Measure: Linear feet of propeller scarring

This measure refers to the propeller scarring of seagrass in the marine environments. Documenting the propeller scarring was suggested across multiple qualities, and propeller scarring of seagrass can impact solitude or primitive recreation opportunities during snorkeling, canoeing, wading, or other activities that allow a person close interaction with seagrass. However, it is best quantified under the Natural Quality and will be monitored with the measure "Total length of propeller scarring of seagrass in Florida Bay."

Indicator: Management Restrictions on Visitor Behavior

Measure: Number of keys closed to visitor access

Key access is a regulation to visitor use, and this regulation is covered under another measure, "index of visitor use management restrictions."

Indicator: Facilities that decrease self-reliant recreation

Measure: Percent of wilderness without cellphone coverage

Solitude encompasses attributes such as separation from people and civilization. Wilderness areas offer a place for people to unplug from electrical devises and tune in to the natural wonders around them. The presence of cellphone coverage has the potential to decrease one's ability to engage in self-discovery, exploration, and freedom from societal influence. The presence of cellphone coverage can reinforce reliance and dependence on cellular devices, which decreases opportunities for self-reliance and causes a lack of preparation and false sense of security. These factors may lead visitors to take unnecessary risks and have unrealistic expectations of emergency personnel.

There is much debate regarding the appropriateness of cellphone coverage in wilderness areas and its effect on the wilderness experience. While the presence of cellphone coverage could lead to the issues identified above, there are no laws or policies prohibiting cellphones or other forms of nonmotorized or nonmechanized technology within wilderness. Two-way radios, a similar device, are an accepted tool within wilderness areas. Visitors to a wilderness area confront wilderness on their own terms and define their own wilderness experience, provided there is no potential to affect the experience of others. Given that no clear guidance regarding cellphone coverage in wilderness areas exists, the decision was made to not include it as a measure at this time.

OTHER FEATURES OF VALUE QUALITY

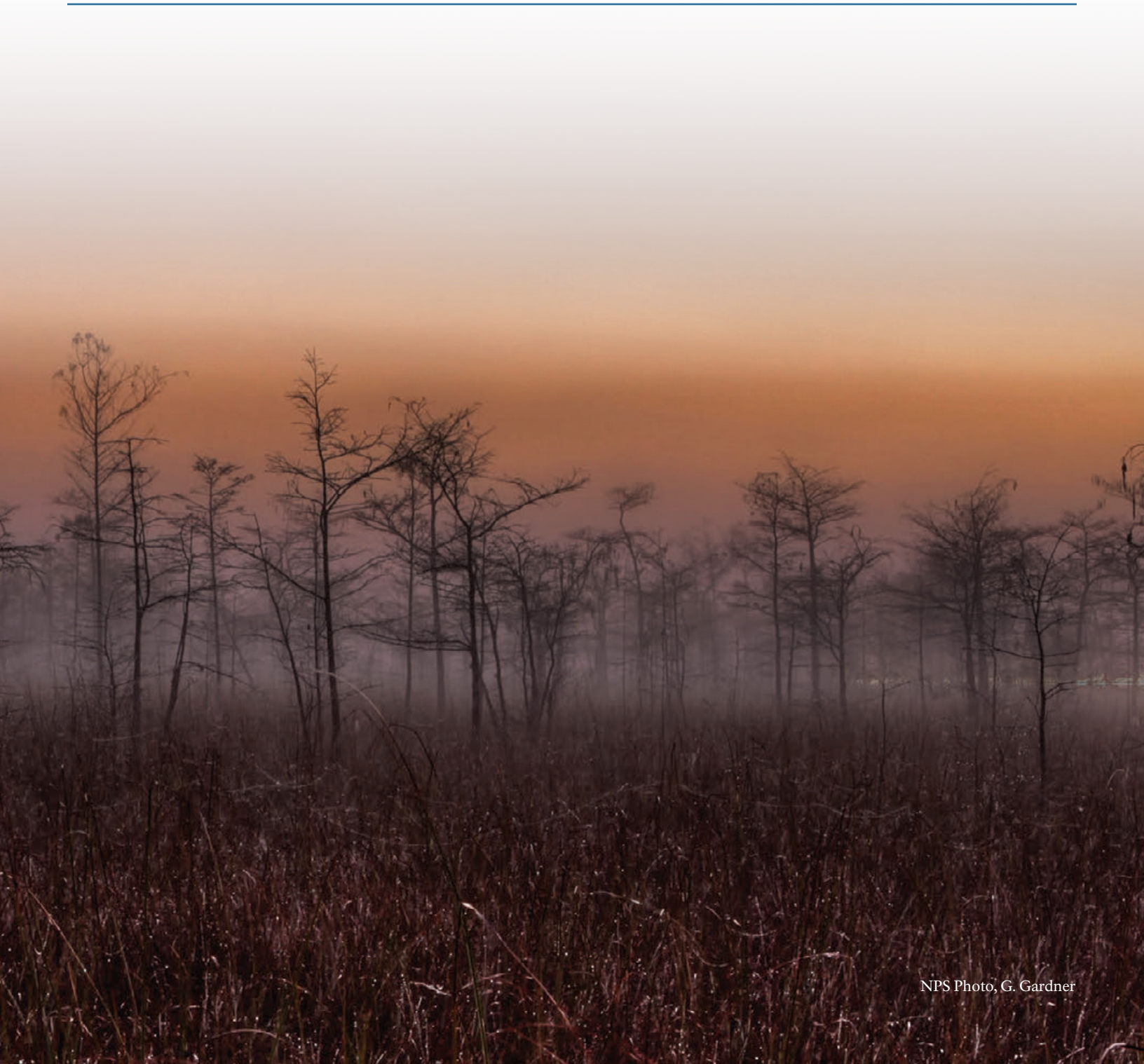
Indicator: Deterioration or loss of integral cultural features

Measure: Percentage of National Register of Historic Places listed or eligible cultural resources in good or fair condition

Historic places and other cultural resources are important because they tell a story about human past, may inform future decision-making, and often yield unique information. These resources are part of the larger transformative message of wilderness, which is that our society has set aside wild places as part of America's enduring heritage, some of which contain landscapes that have been anthropogenically modified or historically developed. They provide touchstones to a place's history and culture, create opportunities for discovery and learning, and enhance our connection to past generations and ancestors.

For the purposes of wilderness character monitoring, specifically for the Other Features of Value Quality, site-specific cultural resources that are unique and integral to wilderness character may be monitored. However, it may not be appropriate to monitor all historic places and cultural resources in the context of wilderness character. National register listing and eligibility may be a good frame of reference for identifying features with historical value but is not the only method. A formal effort is still needed to identify all cultural features with wilderness significance. In lieu of this effort, a conservative approach to wilderness character monitoring was selected that focuses on shell works, with the possibility of including additional features in the future. This approach is not intended to diminish the wilderness significance of other cultural features but to simplify monitoring and acknowledge the need for additional analysis. For these reasons, this measure was not selected.

FUTURE IMPROVEMENTS FOR WILDERNESS CHARACTER MONITORING



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FUTURE IMPROVEMENTS FOR WILDERNESS CHARACTER MONITORING

A number of measures in this report could be improved with additional time and resources. As methods advance, better measures may become available or there may be better ways to perform wilderness character monitoring than those listed in this document. Methods and measures should be updated as better options are developed while taking care not to lose meaningful data.

The following discusses the measures that could be improved upon with some time and effort.

TOTAL LENGTH OF PROPELLER SCARRING OF SEAGRASS IN FLORIDA BAY

This measure will undergo a change in the near future. The park recognizes the need to survey all of Florida Bay, and park staff are currently working on assessing seagrass scarring, as well as evaluating the most appropriate methods by which scars could be identified and analyzed in the future. Once comprehensive data on seagrass scarring in Florida Bay becomes available, this measure will be updated. Regardless of methodology, this measure intends to capture human impact, and thus propeller scarring of seagrass and must *quantify* seagrass scarring.

NIGHT SKY VISIBILITY

While the data provided by the NSNSD is excellent, surveys are extremely infrequent (>5 years). Furthermore, survey locations are not representative of the wilderness as a whole and are generally located near easily accessible areas due to time limitations. It is recommended that future survey locations be distributed throughout the wilderness to provide a good representation of night sky quality. Suggested sites include Jewell Key, Lostman's Key, East Cape Sable, Little Rabbit Key, Shark Valley Tower, Pa-hay-okee, West Lake, and North Nest Key. It is also recommended that the park schedules surveys at least every 5 years through NSNSD. This must be requested by park staff,

with park managers' approval, through the Solution for Technical Assistance Requests (STAR) application at http://irma.nps.gov/Star/.

Another option is for the park to acquire Unidedron Sky Quality Meters or similar devices and implement a local night sky survey program. Surveys could then be conducted once or twice per year near the new moon cycle to ensure that the brightness of the moon does not affect values. The SQM values collected by the Sky Quality Meters would be averaged in a similar fashion to calculate the data value. Should a night sky monitoring program be established, the first year's data would become the new baseline to avoid any discrepancy due to the survey locations and methodology.

INDEX OF NON-RECREATION PHYSICAL DEVELOPMENTS

The accuracy and availability of data for non-recreation physical developments is lacking, especially for research and monitoring installations. While there is good data from research permits regarding what installations were approved to be installed, information is lacking regarding what was actually installed and the eventual removal of installations once a project has concluded. There are likely many more scientific installations in the wilderness than what is being reported in this measure due to abandoned infrastructure. Some thought should be given on how to improve reporting of this data in the future. This can be a change in the MRA process such as adding periodic dialogue with current permit holders or a formal review process for on-going projects. A central database for these developments would assist in documentation purposes. The database can include other important information such as date of installation, GPS coordinates, and current usages.

Furthermore, developments of modern humans that exist on historic sites in the park were not included in the report. An effort to document these developments could be made and additional surveying of cultural resources could occur to provide more general information.

INDEX OF AUTHORIZED USE OF MOTOR VEHICLES, MOTORIZED EQUIPMENT, AND MECHANICAL TRANSPORT

Data for this measure is inconsistent and incomplete therefore a baseline data value was not identified for this report. This data is not currently required to be recorded by individuals in a detailed way, and the data is not collected or recorded in a centralized location. A comprehensive, collaborative and interdivisional reporting process and centralized database is necessary to improve accuracy of this measure. Of all the measures, this one is in need of the most improvement in the documentation process. This is especially true due to its importance and large impact on wilderness character.

NUMBER OF SHELL WORKS THAT HAVE RECEIVED A "POOR" CONDITION ASSESSMENT SINCE WILDERNESS DESIGNATION

The exact number of shell works sites is generally unknown in the MSD Wilderness and other lands managed as wilderness at Everglades National Park. More extensive and broad surveying and documentation is needed of the park to get a more accurate data value. Furthermore, the wilderness significance of other cultural resources should continue to be evaluated and incorporated into monitoring, as appropriate.

CONCLUSION | REFERENCES | GLOSSARY

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CONCLUSION

As mandated by NPS Director's Order 41 (NPS 2013a), this document provides Everglades National Park with an official Wilderness Character Narrative, the establishment of baseline wilderness character measures and data, and a framework for continuing this monitoring to assess changes in wilderness character far into the future. In providing these building blocks for wilderness stewardship, this report also serves as a foundation document to support the process of developing a wilderness stewardship plan at Everglades National Park. Beyond fulfilling these policy requirements, this report seeks to empower park managers to make carefully weighed wilderness stewardship decisions with the ultimate goal of facilitating the preservation of wilderness character.

The measures selected for wilderness character monitoring by this assessment are not all-inclusive or comprehensive. Future monitoring should continue to revisit the adequacy of these measures and their data sources, and new measures should be incorporated if new issues become relevant to wilderness character or new data become available. To fully realize the investment in this monitoring program and ensure its credibility, any future changes must be carefully documented and should only be made if necessary or if having a demonstrable positive long-term effect on this program.

Through the lens of this wilderness character monitoring framework, Everglades National Park managers can rely on the 18 measures selected and outlined in this assessment to monitor how the five tangible qualities of wilderness character changes over time within the MSD Wilderness and other park lands managed as wilderness.

In addition to these five tangible qualities of wilderness character, wilderness also has important intangible aspects that are difficult or impossible to quantify or monitor. These intangible aspects are diverse and can include scenic beauty, spiritual experiences, immensity of an area, and opportunities for adventure, inspiration, or relaxation that come from wilderness settings. As Marjory Stoneman Douglas once wrote,

> *There are no other Everglades in the world. They are, they have always been, one of the unique regions of the earth, remote, never wholly known. Nothing anywhere else is like them; their vast glittering openness, wider than the enormous visible round of the horizon, the racing free saltness and sweetness of their massive winds, under the dazzling blue heights of space. They are unique also in the simplicity, the diversity, the related harmony of the forms of life they enclose. The miracle of the light pours over the green and brown expanse of saw grass and of water, shining and slow-moving below, the grass and water that is the meaning and the central fact of the Everglades of Florida. It is a river of grass.*

These types of intangible aspects of the MSD Wilderness and other lands managed as wilderness at Everglades National Park are addressed in the narrative.

Wilderness character can change over time and can be improved or diminished by the actions or inaction of land managers. Wilderness stewardship is challenging, and big questions must continually be discussed and revisited over time. The decision to acknowledge and begin to understand these wilderness challenges is of the same fuel that inspires one to get to the top of the highest peak or slog deep into the swampiest jungles. This report, the measures of wilderness character, and the wilderness character narrative will aid in wilderness stewardship by informing managers of local trends that give managers a better understanding of the wilderness they manage. However, the completion of this baseline assessment does not automatically ensure the preservation of wilderness character. Facing many challenges (e.g., ecological restoration, fire management) and threats (e.g., climate change, invasive species, encroaching development), park managers must continue to improve stewardship practices that uphold the Wilderness Act's mandate to preserve wilderness character.

Furthermore, to obtain an even better understanding, if not the best, one must go explore the wilderness they manage, as a wilderness cannot fully be understood behind a desk or read in a book or in a document. A wilderness must be explored, heard, seen, touched, tasted, and felt from within.

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GLOSSARY

Administrative use—use authorized by the National Park Service that is considered to be necessary to meet minimum requirements for the administration of the area (NPS draft "Wilderness Character Monitoring Technical Guide").

Aircraft, Landing of—bringing down to the surface of the earth (land, water, snow, or ice) any aircraft or anything attached to or carried by an aircraft, during or after a flight (NPS *Reference Manual #41*, Wilderness Definitions).

Authorized—includes all agency staff as well as personnel under current permits or agreements with Everglades National Park. These authorizations generally include, but are not limited to, a Minimum Requirements Analysis, National Environmental Policy Act decision document, permit, supervisor's approval, and/or the superintendent's approval (Everglades National Park staff).

Inholding—land owned or managed by an entity other than the National Park Service that is within the designated, recommended, proposed, eligible wilderness boundary (NPS *Reference Manual #41*, Wilderness Definitions).

Installation—anything made by humans that is not intended for human occupation and is left unattended or left behind when the installer leaves the wilderness (NPS *Reference Manual #41*, Wilderness Definitions).

Invasive species—a nonnative organism whose introduction causes or is likely to cause economic or environmental harm, or harm to human, animal, or plant health (Executive Order #13751, 2016).

Mechanical transport—any contrivance for moving people or material in or over land, water, snow, or air that has moving parts and is powered by a living or non-living power source. This includes (but is not limited to) wheeled vehicles, devices, or contrivances, such as bicycles, Segways™ and other Electric Personal Assistance Mobility Devices, game carriers, travois, carts, wheelbarrows, and wagons. "Mechanical transport" does not include skis, snowshoes, sleds, travois, nonmotorized river craft including drift boats, rafts, or canoes, or similar primitive devices. Wheelchairs or other mobility devices that meet the definition of "wheelchair" in the Americans with Disabilities Act, section 508(c) are not prohibited in wilderness (NPS *Reference Manual #41*, Wilderness Definitions).

Motor vehicle—any vehicle which is self-propelled, including any vehicle that is propelled by electric power but not operated on rails or upon water. This includes, but is not limited to cars, trucks, all-terrain vehicles (ATV) and motorcycles (NPS *Reference Manual #41*, Wilderness Definitions).

Motorized equipment—any machine that applies force by transferring energy from a motor, engine, or other non-living power source. This includes but is not limited to, such machines as aircraft, drones, snowmobiles, motorboats, chainsaws, weed whackers, power drills, power saws, generators, compressors, windmills or turbines, and now or leaf blowers. "Motorized equipment" does not include shaves, wrist watches, clocks, flashlights, cameras, camping stoves, solar panels, batteries, explosives, Geiger counters, cellular telephones, portable electric media devices, radio receivers or transmitters, GPS units, or other similar small, battery-powered, hand-carried personal camping equipment (NPS *Reference Manual #41*, Wilderness Definitions).

Persistent Installation—an installation in place for a prolonged period of time (greater than one year) intended to purposefully alter, hinder, restrict, control, or manipulate the earth and its community of life. Examples include, but are not limited to fish barriers, dams, water diversions, guzzlers, bat gates, or fencing (adapted from *Keeping It Wild 2*).

Structure—anything made by humans that is intended for human occupation, or their possessions, and is left behind when the builder leaves the wilderness (NPS *Reference Manual #41*, Wilderness Definitions).

Synthetic SQM—the "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}. . .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" (NPS n.d.b.).

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APPENDICES

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APPENDIX A: OVERVIEW OF THE FRAMEWORK FOR WILDERNESS CHARACTER MONITORING

An excerpt from *Keeping it Wild 2* (Landres et al. 2015):

This interagency monitoring strategy is organized around a hierarchical framework that divides wilderness character into successively finer components. These components, starting from wilderness character, are:

- ***Qualities***. Qualities are the primary elements of wilderness character that link directly to the statutory language of the Wilderness Act. The same set of qualities applies nationwide to all wildernesses managed by all agencies. In this framework, the untrammeled, natural, undeveloped, and solitude or primitive and unconfined recreation qualities are all necessary to assess trend in wilderness character, and each wilderness would report the trend in each of these qualities. Where other features of value exist in a wilderness and are integral to it, the Other Features of Value Quality would also be reported.
- ***Monitoring questions***. Monitoring questions capture essential components of each quality that are significantly different from one another and address particular management questions and goals. The same set of monitoring questions applies nationwide to all wildernesses.
- ***Indicators***. Indicators are distinct and important components under each monitoring question. There is more than one indicator for nearly all monitoring questions. Each wilderness and agency would be responsible for reporting the trend in all indicators. The same set of indicators applies nationwide to all wildernesses managed by all agencies.
- ***Measures***. Measures are the specific elements under each indicator for which data are collected to assess trend in an indicator. In general, measures are human-caused threats to the indicator. Each agency is responsible for determining how its measures will be selected (that is, whether by a national or regional team, or by each wilderness). Examples of measures for each indicator are given in the sections that describe each quality in detail.

This hierarchical framework allows managers to look at the overall trend in wilderness character and drill down through the various levels to understand how this trend was derived, including how change in an individual measure contributes to the overall trend in wilderness character.

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APPENDIX B: SUMMARY OF EFFORT REQUIRED FOR WILDERNESS CHARACTER MONITORING

Table B-1. Measures, Data Sources, and Hours: Untrammeled Quality

Measure	Type of Data Source	Hours to Gather Data	Comments
Number of authorized actions and persistent installations designed to manipulate plants, animals, pathogens, soil, water, or fire	Office and computer files, professional knowledge	5	The wilderness coordinator should keep track of this annually. Check with various resource specialists, research permits, hydrologists, and staff members who have a good understanding of trammeling actions in the park. Talk with fire management team. Suggest recording information relative to wilderness as part of fire recording protocol to create ease of data sharing in the future.

Table B-2. Measures, Data Sources, and Hours: Natural Quality

Measure	Type of Data Source	Hours to Gather Data	Comments
Index of priority invasive plant species	Professional knowledge	1	Check with nonnative plant specialist to understand on-going field projects.
Total length of propeller scarring of seagrass in Florida Bay	Research study	2	Check with marine biologists to understand new and on-going seagrass studies.
Presence of nonnative fishes	Professional knowledge	1	Check with fisheries biologist to understand on-going field projects.
Index of visibility	Internet	1	Pull data from VIEWS website. Minor calculations required.
Concentration of nitrogen in wet deposition	Internet	1	Pull data from NADP/NTN website, minor calculations required.
Concentration of sulfur in wet deposition	Internet	1	Pull data from NADP/NTN website, minor calculations required.
Index of total phosphorus concentrations in periphyton	Internet	5	Pull data from SFWMD website, minor calculations required.
Percentage of acres within the maximum expected fire return interval	Computer files, professional knowledge	5	Use GIS data of plant community type, maximum fire return interval, and areas burned within the maximum fire return interval to calculate percentage

Table B-3. Measures, Data Sources, and Hours: Undeveloped Quality

Measure	Type of Data Source	Hours to Gather Data	Comments
Index of non-recreation physical developments	Professional knowledge, GIS files	5	The wilderness coordinator should keep track of any new installations or loss of developments annually. Check with the maintenance, cultural resources, biologists, and GIS specialists for new information.
Number of inholdings	Internet, GIS files	1	The wilderness coordinator should monitor existing mineral rights.
Index of authorized use of motor vehicles, motorized equipment, and mechanical transport	Professional knowledge, survey	40	The wilderness coordinator should diligently keep track of staff and permittees who are authorized to use vehicles, aircraft, or motorized equipment in wilderness. A formal process must be established for all individuals whether it is a centralized reporting system or an established reporting document is required to continue using vehicles.

Table B-4. Measures, Data Sources, and Hours: Solitude or Primitive and Unconfined Recreation Quality

Measure	Type of Data Source	Hours to Gather Data	Comments
Acres of wilderness away from access and travel routes and developments inside wilderness	Professional knowledge, GIS files	5	The wilderness coordinator should keep track of any new installations or loss of developments annually. Use GIS data of access and travel routes and developments to calculate acreage.
Acres of wilderness away from adjacent travel routes and developments outside wilderness	Professional knowledge, GIS files	5	The wilderness coordinator should keep track of any new installations or loss of developments annually. Use GIS data of access and travel routes and developments to calculate acreage.
Night sky visibility	Research study	5	Check with local staff and NPS Natural Sound and Night Sky Division to understand new and on-going night sky studies.
Index of authorized constructed or improved recreation facilities	Professional knowledge, GIS files, park maps	2	The wilderness coordinator should keep track of any new installations or loss of facilities annually. Check with the maintenance, cultural resources, and GIS specialists for new information.
Index of visitor use management restrictions	Office files, park compendium, fishing regulations	2	New and modified visitor use regulations should be examined and compared with existing regulation themes.

Table B-5. Measures, Data Sources, and Hours: Other Features of Value Quality

Measure	Type of Data Source	Hours to Gather Data	Comments
Number of shell works that have received a "poor" condition assessment since wilderness designation	CRIS, professional knowledge	1	The wilderness coordinator should work with Cultural Resource Managers to keep an updated list of shell works sites and current conditions.

APPENDIX C: DATA SOURCES AND PROTOCOLS FOR ALL MEASURES USED

This appendix contains a brief summary of the data sources and collection protocols for each measure.

Table C-1. Data Sources and Collection Protocols: Untrammeled Quality

Number of authorized actions and persistent installations designed to manipulate plants, animals, pathogens, soil, water, or fire.	**Baseline Data Sources:** (1) PJ Walker (pj_walker@nps.gov)—Wilderness Coordinator, Everglades National Park. (2) Fred Herling (fred_herling@nps.gov)—Former Supervisory Park Planner, Everglades and Dry Tortugas National Parks. (3) Pat Edwards (patrick_edwards@nps.gov)—Fuels Technician, Everglades National Park. (4) Maya Tupaj (mayavati_tupaj@nps.gov)—Fire Ecologist, Everglades National Park. (5) Hillary Cooley (hillary_cooley@nps.gov) - Botanist, Everglades and Dry Tortugas National Park. (6) Jimi Sadle (jimi_sadle@nps.gov)—Supervisory Botanist, Everglades National Park. (7) Bryan Falk (bryan_falk@nps.gov)—Supervisory Invasive Species Biologist, Everglades and Dry Tortugas National Parks. (8) Tylan Dean (tylan_dean@nps.gov)—Biological Resources Branch Chief, Everglades and Dry Tortugas National Parks. (9) Erik Stabenau (erik_stabenau@nps.gov)—Supervisory Hydrologist and Physical Branch Chief, Everglades National Park. (10) Amy Renshaw (amy_renshaw@nps.gov)—Hydrologist. **Protocol:** Consult with relevant staff to develop a count of trammeling actions. Guidance for counting trammeling actions can be found in appendix D. **Data Source:** Data is locally compiled. Because of the wide variety of action types counted under this measure, there is no single source for data. A recommended starting point in the compilation of data for this measure is to coordinate with park managers and park and region resource specialists to compile a list of readily known actions (including persistent installations), and to gauge the level of confidence that this list is comprehensive (Table 6. Data Sources for Different Types of Trammeling Actions). If this initial list of actions is not comprehensive, other potential data sources to confirm whether or not additional actions were implemented include MRAs, NEPA documents, Pesticide Use Proposals, special use permits, research permits, fire burn plans, ICS-209 forms, and NPS databases (e.g., PEPC, FMSS). **Collect & Report:** Report annually. Data collected for the fiscal year.

Table C-2. Data Sources and Collection Protocols: Natural Quality

Measure	Detailed Description of the Data Source(s) and Protocols for How the Data Were Gathered
Index of priority invasive plant species	**Baseline Data Sources:** Hillary Cooley (hillary_cooley@nps.gov) - Botanist, Everglades and Dry Tortugas National Park. **Protocol:** Document the total abundance index sums for each priority species from data obtained in systematic reconnaissance flights. The data value should be determined by the Exotic Vegetation Program Manager, using data acquired from the South Florida/ Caribbean Inventory and Monitoring Network. Reference Table 9 for current list of nonnative plant species. **Data Source:** Botanist, Invasive Species Program, Everglades and Dry Tortugas National Parks. **Collect & Report:** Report every five years when new data becomes available.

Measure	Detailed Description of the Data Source(s) and Protocols for How the Data Were Gathered
Total length of propeller scarring of seagrass in Florida Bay	**Baseline Data Sources:** (1) Atkins. (2017). Snake Bight Pole Troll Zone: Revegetation Monitoring and Analysis. Final Report. Everglades National Park. Contract No. P11PC21000, Task Order No. P15PD03383. (2) Matt Patterson (matt_patterson@nps.gov)—Marine Ecologist, Everglades and Dry Tortugas National Parks. **Protocol:** Document the sum total length of seagrass scars within three representative zones in Florida Bay: (1) the Snake Bight Pole/Troll Zone (PTZ), (2) Reference Area 1 located just south of the Snake Bight PTZ, and (3) Reference Area 2 located in southern Florida Bay. A larger portion of Florida Bay may be incorporated in the future. **Data Source:** There is currently no regularly scheduled assessment of seagrass scarring in the MSD Wilderness, however regular monitoring efforts are intended to occur in the future. **Collect & Report:** Report every five years. Data collected from the most recent aerial or boat survey.
Presence of nonnative fishes	**Baseline Data Sources:** Jeff Kline (jeff_kline@nps.gov)—Fisheries Biologist, Everglades National Park. **Protocol:** Document the aggregate number of nonnative fish species observed at 46 fixed plots within wilderness represented as a three-year moving average. Total the number of nonnative fish species captured per site for each year, sum the totals of all sites, then calculate the three-year moving average to obtain the data value. **Data Source:** Fisheries Biologist, Everglades National Park. **Collect & Report:** Report annually. Data compiled and analyzed annually after each sampling season.
Haze on mid-range days	**Baseline Data Sources:** NPS Air Resources Division: https://www.nps.gov/subjects/air/park-conditions-trends.htm **Protocol**: Go to https://www.nps.gov/subjects/air/park-conditions-trends.htm. Select *Everglades NP* from the Park dropdown. Select *Visibility* from the Parameter dropdown. In the Summary tab, click on Rationale +. Haze on mid-range days is reported in the *Condition* text. Record the first numeric for deciviews from the *Condition* text. Add that value to the value for estimated annual average natural condition on mid-range days (n=7.1) to obtain the measure data value. **Data Source:** NPS Air Resources Division: https://www.nps.gov/subjects/air/park-conditions-trends.htm **Collection & Report:** Report annually. Data are compiled and analyzed annually once new data becomes available. Note that due to quality assurance and data analysis procedures, there is usually a one-year lag time between the current year and the most recent available five-year average value.
Concentration of inorganic nitrogen in wet deposition	**Baseline Data Sources:** NPS Air Resources Division: https://www.nps.gov/subjects/air/park-conditions-trends.htm **Protocol**: Go to https://www.nps.gov/subjects/air/park-conditions-trends.htm. Select *Everglades NP* from the Park dropdown. Select *Nitrogen Deposition* from the Parameter dropdown. In the Summary tab, click on Rationale +. Nitrogen deposition is reported in the Condition text. Record the number from the *Condition* text in kg/ha/yr. If a range is given, use the maximum of the range. **Data Source:** NPS Air Resources Division: https://www.nps.gov/subjects/air/park-conditions-trends.htm **Collection & Report:** Report annually. Data are compiled and analyzed annually once new data becomes available. Note that due to quality assurance and data analysis procedures, there is usually a one-year lag time between the current year and the most recent available five-year average value.

Measure	Detailed Description of the Data Source(s) and Protocols for How the Data Were Gathered
Concentration of sulfur in wet deposition	**Baseline Data Sources:** NPS Air Resources Division: https://www.nps.gov/subjects/air/park-conditions-trends.htm **Protocol**: Go to https://www.nps.gov/subjects/air/park-conditions-trends.htm. Select *Everglades NP* from the Park dropdown. Select *Sulfur* from the Parameter dropdown. In the Summary tab, click on Rationale +. Sulfur deposition is reported in the Condition text. Record the number from the *Condition* text in kg/ha/yr. If a range is given, use the maximum of the range. **Data Source:** NPS Air Resources Division: https://www.nps.gov/subjects/air/park-conditions-trends.htm **Collection & Report:** Report annually. Data are compiled and analyzed annually once new data becomes available. Note that due to quality assurance and data analysis procedures, there is usually a one-year lag time between the current year and the most recent available five-year average value.
Index of total phosphorus concentrations in periphyton	**Baseline Data Sources:** Dr. Evelyn Gaiser, Florida International University. **Protocol**: Determine the total phosphorous content for periphyton samples from each principal sampling unit. Compare the total phosphorus mean from each principal sampling unit to baseline expectations or standards established for indicator regions and assign a color code to each principal sampling unit based on deviation from those standards. Each color code is then assigned a weight, which is then summed per year. The yearly sums are used to calculate a three-year moving average, which is the data value. **Data Source:** Dr. Evelyn Gaiser, Florida International University. **Collection & Report:** Compile and analyze data annually once new data becomes available.
Percentage of acres within the maximum expected fire return interval	**Baseline Data Sources:** Maya Tupaj—Fire Ecologist, Everglades National Park. **Protocol:** Calculate the percentage of burnable acres within wilderness that have burned within the maximum expected fire return interval. Computation of this measure is a GIS exercise and is best conducted by someone who is familiar and experienced with GIS analysis as well as the fire management program. **Data Source:** Fire Ecologist, Everglades National Park. **Collection & Report:** Report every five years. Park staff may choose to calculate this measure annually to provide a more complete picture.

Table C-3. Data Sources and Collection Protocols: Undeveloped Quality

Measure	Detailed Description of the Data Source(s) and Protocols for How the Data Were Gathered
Index of non-recreation physical developments	**Baseline Data Sources:** (1) PJ Walker (pj_walker@nps.gov)—Wilderness Coordinator, Everglades National Park. (2) Caryl Alarcon (caryl_alarcon@nps.gov)—GIS Specialist, South Florida National Parks. (3) Penelope Del Bene (penelope_delbene@nps.gov)—Former Chief of Cultural Resources, Everglades and Dry Tortugas National Parks. (4) FMSS. **Protocol:** Calculate an index of the quantity and type of non-recreation physical developments, installations, or structures that are currently in the wilderness. Document developments as they occur and when they are demolished. **Data Source**: Wilderness Coordinator; GIS Specialist; Chief of Cultural Resources. Consult minimum requirements analyses, new research permits, NEPA documents, GIS files, and associated staff members for new and additional non-recreation developments. **Collect & Report:** Report annually. Data collected from research permits and GIS specialist.

Measure	Detailed Description of the Data Source(s) and Protocols for How the Data Were Gathered
Number of inholdings	**Baseline Data Sources:** Caryl Alarcon (caryl_alarcon@nps.gov)—GIS Specialist, South Florida National Parks. Fred Herling (fred_herling@nps.gov)—Former Supervisory Park Planner. (3) Tatiana Marquez (tatiana_marquez@nps.gov)—Park Planner. **Baseline Protocol:** Document any inholdings that may occur in the future. **Collect & Report:** Report every five years. Data collected from GIS specialist.
Index of authorized use of motor vehicles, motorized equipment, and mechanical transport	**Baseline Data Sources:** All park staff and active research permittees were contacted directly and asked to respond to a motorized vehicle use survey. **Protocol:** Calculate the total number of administrative authorizations to use motor vehicles, motorized equipment, or mechanical transported. Weight each authorization by its equipment type. **Data Source:** Individual use data will be submitted upon request from known NPS staff and permittees that participate in mechanical transport and motorized vehicle use in wilderness areas. Completed MRAs will also be referenced to determine authorized amounts and who should be contacted to obtain actual numbers. **Collect & Report:** Report annually. Data collected for the calendar year.

Table C-4. Table C-1. Data Sources and Collection Protocols: Solitude or Primitive and Unconfined Recreation Quality

Measure	Detailed Description of the Data Source(s) and Protocols for How the Data Were Gathered
Acres of wilderness away from access and travel routes and developments inside wilderness	**Baseline Data Sources:** (1) PJ Walker (pj_walker@nps.gov)—Wilderness Coordinator, Everglades National Park. (2) Caryl Alarcon (caryl_alarcon@nps.gov)—GIS Specialist, South Florida National Parks. **Protocol:** To perform the spatial analysis and calculate the data value for this measure, first buffer all identified routes and developments outside wilderness by ½ mile. Subtract the buffered area from the wilderness polygon, and then calculate the remaining area to determine the acres of wilderness away from internal routes and developments. **Data Source:** Park GIS Specialists. Research Permit Files. FMSS. **Collect & Report:** Report every five years. Data collected from GIS specialist and research permit files.
Acres of wilderness away from adjacent travel routes and developments outside wilderness	**Baseline Data Sources:** (1) PJ Walker (pj_walker@nps.gov)—Wilderness Coordinator, Everglades National Park. (2) Caryl Alarcon (caryl_alarcon@nps.gov)—GIS Specialist, South Florida National Parks. **Protocol:** To perform the spatial analysis and calculate the data value for this measure, first buffer all identified routes and developments inside wilderness by ½ mile. Subtract the buffered area from the wilderness polygon, and then calculate the remaining area to determine the acres of wilderness away from internal routes and developments. **Data Source:** (1) Park GIS Specialist. (2) Research Permit Files. (3) FMSS. **Collect & Report:** Report every five years. Data collected from GIS specialist and research permit files.
Night sky visibility	**Baseline Data Sources:** National Park Service's Night Sky Monitoring Database https://www.nps.gov/subjects/nightskies/skymap.htm **Protocol:** The data value is the sum average of the synthetic SQM value reported for each site location. Data and site locations are produced by the NPS Natural Sounds and Night Skies Division (NSNSD). **Data Sources:** National Park Service's Night Sky Monitoring Database. https://www.nps.gov/subjects/nightskies/skymap.htm **Collect & Report:** Report every five years. Data is collected from the most recent study.

Measure	Detailed Description of the Data Source(s) and Protocols for How the Data Were Gathered
Number of authorized constructed or improved recreation features	**Baseline Data Sources:** (1) Mike Jester (michael_jester@nps.gov)—Former Chief Facility Manager, Everglades and Dry Tortugas National Parks. (2) Caryl Alarcon (caryl_alarcon@nps.gov)—GIS Specialist, South Florida National Parks. (3) The official Everglades National Park map was referenced to determine number of named trails. (4) The official "Wilderness Trip Planner" was consulted to determine number of existing toilets and docks. (5) 1981 Backcountry Management Plan. **Protocol:** Count the total number of authorized constructed recreation features located within wilderness, such as trails, campsites, toilets, fire grates, interpretive signs, and trash cans. **Data Source:** (1) FMSS. (2) Park GIS specialists. (3) The "Wilderness Trip Planner" **Collect & Report:** Report every five years. Data is collected using GIS files or FMSS databases.
Index of visitor use management restrictions	**Baseline Data Sources:** (1) 1988 Everglades National Park Compendium: Code of Federal Regulations. (2) 2020 Everglades National Park Compendium: Code of Federal Regulations. (3) Everglades Fishing Regulations guide. **Protocol:** The regulation total is calculated by identifying existing regulations to visitor use recreation that apply to wilderness areas. These individual regulations are categorized by themes existing in the regulation documents. Each regulation is given a "Severity Score" based on the current type of regulation. The data value for this measure is the sum total of the total regulations that exist in wilderness areas. **Data Source:** (1) Everglades National Park Compendium: Code of Federal Regulations. (2) Everglades Fishing Regulations guide. **Collect & Report:** Report every five years. Data is collected from the park's rules and regulations documents.

Table C-5. Data Sources and Collection Protocols: Other Features of Value Quality

Measure	Detailed Description of the Data Source(s) and Protocols for How the Data Were Gathered
Number of shell works that have received a "poor" condition assessment since wilderness designation	**Baseline Data Sources:** (1) Cultural Resources Inventory System (CRIS). (2) Greg Luna Golya—Former Archeologist, Everglades and Dry Tortugas National Parks. **Protocol:** The data value is the total number of individual shell works and shell middens that have received a "poor" condition assessment since wilderness designation. This data value is derived from the Cultural Resources Inventory System (CRIS). **Data Source:** (1) Cultural Resources Inventory System (CRIS). (2) Archeologist, Everglades and Dry Tortugas National Parks. **Collect & Report:** Report every five years. Data is collected from the CRIS website by an authorized staff member.

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APPENDIX D: WHAT IS A TRAMMELING ACTION?

Appendix extracted from *Keeping it Wild 2* (Landres et al. 2015):

This appendix provides guidelines and examples to clarify what is and is not a trammeling action. These are intended to capture about 90% of the cases and provide sufficient guidance for local staff to figure out the novel and rarer cases as they occur. A trammeling action is defined as an action that intentionally manipulate "the earth and its community of life" inside a designated wilderness or inside an area that by agency policy is managed as wilderness.

The following terms and phrases clarify this definition above:

- **Intentional:** done on purpose; deliberate; willful.
- **Manipulation**: an action that alters, hinders, restricts, controls, or manipulate "the earth and its community of life" including the type, amount, or distribution of plants, animals, or physical resources.
- **Intentional manipulation**: an action that purposefully alters, hinders, restricts, controls, or manipulates "the earth and its community of life."

The concepts are crucial for understanding what is and is not a trammeling action: restraint and intention. Retraining our power to manipulate or control the earth and its community of life is at the core of the Undeveloped Quality of wilderness character. Trammeling actions occur when opportunities for restraint are ignored or bypassed; when there is no opportunity for restraint, there is no opportunity to trammel. Wilderness legislation and policies mandate that managers exercise restraint when authorizing actions that interfere with or control wilderness ecological systems. While other agencies, organizations, and the public are not beholden to these same restrictions, activities that have not been authorized by the federal land manager and that manipulate the wilderness environment are counted as trammeling actions.

The second concept central to the idea of trammeling is intentionality. Actions that deliberately interfere with, manage, or control an aspect of wilderness ecological systems are intentional and clear instances of trammeling. As explained in the chapter on the Untrammeled Quality, intentional actions are counted as a trammeling regardless of the magnitude of their effects (including areal extent, intensity, frequency, and duration). For pragmatic reasons, however, some actions are not monitored if they fall below a minimum practical threshold of scale and score (for example, hand pulling a few individual noxious plants). Much more complex and nuanced is determining whether to include actions whose purpose is not to manipulate the earth and its community of life, but some manipulation of the environment is required to produce the desired outcome. These types of actions can be confusing because the biophysical environment is intentionally manipulated even though it is not the purpose behind the action. In general, when such actions have substantial and foreseeable effects on the wilderness ecosystem, they are counted as trammeling.

The following sections describe three types of activities: those that are authorized by the federal wilderness manager, and those that are not. Three subclasses under each of these reflect whether the action is taken on a biological resource, on a physical resource, or on a resource outside the wilderness with the intent to manipulate biophysical resource within the wilderness.

Agency authorized trammeling actions. These are actions that are authorized by the federal wilderness manager as well as actions by other agencies, organizations, or individuals that have been approved or permitted by the federal land manager.

1. Actions taken inside the wilderness on a *biological* resource to intentionally affect "the earth and its community of life." Examples include:
    a. Removing or killing indigenous or non-indigenous vegetation or fish and wildlife.
    b. Adding or restoring indigenous or non-indigenous vegetation or fish and wildlife.
    c. Using chemicals or biocontrol agents to control indigenous or non-indigenous vegetation or fish and wildlife.
    d. Collecting, capturing, or releasing plants and animals under a research permit.
    e. Enclosing or excluding fish and wildlife from an area.

2. Actions taken inside the wilderness on a *physical* resource or natural process to intentionally affect "the earth and its community of life." Examples include:
    a. Suppressing naturally ignited fire.
    b. Lighting fire (under management prescription) for any purpose.
    c. Constructing or maintaining a dam, water diversion, guzzler, or other persistent installations intended to continuously alter wilderness hydrology; each agency will need to determine their counting rules for monitoring such installations.
    d. Adding acid-buffering limestone to water to neutralize the effects of acid deposition.
3. Actions taken *outside* the wilderness on a physical or biological resource or process to intentionally affect 'the earth and its community of life" inside a wilderness. Examples include:
    a. Cloud seeding to intentionally increase prescription inside the wilderness.
    b. Damming a river outside a wilderness to intentionally alter the hydrology inside the wilderness.
    c. Killing fish and wildlife outside the wilderness or planting or stocking fish and wildlife outside the wilderness to intentionally affect the population or distribution of this species inside the wilderness.

Unauthorized trammeling actions. These are citable or other actions taken by other agencies, organizations, or individuals that have not been authorized, approved, or permitted by the federal wilderness land manager.

1. Actions taken inside the wilderness on a *biological* resource to intentionally affect "the earth and its community of life." Examples include:
    a. Adding or removing plants or fish and wildlife.
    b. Other direct manipulation of plants or fish and wildlife.
    c. Indirect manipulation of fish and wildlife, such as changing hunting regulations with the goal or decreasing predator populations within the wilderness.
2. Actions taken inside the wilderness on a *physical* resource or natural process to intentionally affect "the earth and its community of life." Examples include:
    a. Setting arson fire.
    b. Modifying water resources to provide water for wildlife, or otherwise store water or alter the timing of water flow.
3. Actions taken *outside* the wilderness on a physical or biological resource to intentionally affect "the earth and its community of life" inside a wilderness. Examples include:
    a. Releasing or killing species outside of the wilderness with the intention to affect populations whose ranges expand into the wilderness.

In some situations, staff may assume that they do not have the opportunity for restraint because an action is required to comply with other laws or agency policies, or to protect human life or property. Examples of such situations include restoring habitat for a listed endangered species, spraying herbicides to eradicate an invasive non-indigenous plant that is degrading wildlife habitat, transplanting an extirpated species back into the wilderness, or suppressing a naturally ignited fire. These are still considered trammeling actions because even in these situations staff are deciding to take action as well as deciding the type and intensity of action.

ACTIVITIES THAT ARE NOT TRAMMELING ACTIONS:

Actions for which there is no opportunity for managerial or individual restraint are not considered a trammel. For example, climate change, air pollutants wafting into a wilderness, and the presence of non-indigenous species that naturally dispersed into a wilderness are not intentional decisions or actions, and therefore do not provide an opportunity for management restraint. Accidental unauthorized actions, such as escaped campfires and oil spills, similarly lack an opportunity to retrain our power over the landscape. Past actions that manipulated the biophysical environment before the area was designated as wilderness are not considered a trammel because the provisions of the Wilderness Act did not apply to the area prior to designation.

Another group of examples that are not trammeling encompass those small-scale actions with no intent to manipulate the earth and its community of life, such as installing meteoroidal or other science instrumentation, landing a helicopter for search and rescue operations, and removing trash. Camping violations, unauthorized motorized incursions, and other illegal activities are not intended to manipulate the biophysical environment are also not counted a trammeling actions; legality is irrelevant in determining whether an action is trammeling or not.

Hunting, for sport or subsistence, has provoked an enormous amount of discussion about whether it degrades the Untrammeled Quality. The consensus from the Lessons Learned Workshop was that hunting is generally not a trammeling action because individual hunters are taking individual animals without the intention to manipulate the wildlife population. However, if a state wildlife agency manipulates hunting quotas (or takes other management action) to alter the predator/prey relationship in order to maximize certain hunting opportunities, this manipulation of the "community of life" would degrade the Untrammeled Quality (see above).

ACTIVITIES THAT MAY BE TRAMMELING ACTIONS:

There are two types of actions that may or may not be considered trammeling actions. The first includes intentional manipulations that interfere with or control an aspect of wilderness ecosystems but are too small in scale or scope to be practically monitored. The second type encompasses those nuanced cases where the primary purpose of the actions is not to manipulate the ecosystem but a foreseeable and substantial effect on the earth and its community is required to achieve this purpose. As shown in the table below, several hypothetical situations illustrate how an action may or may not be trammeling depending on the extent of the action and its effects. Each bullet in the table presents a situation where the action being taken likely would, or would not, be considered trammeling.

Table D-1. Examples of Actions That Are "Likely Not" and Are "Likely" Trammeling Actions Based on the Scale and Scope of the Actions and Its Effects on the Earth and Its Community of Life

Action	Likely Not a Trammel	Likely a Trammel
Treating non-indigenous invasive plants	• Hand pulling a small area of non-indigenous invasive plants	• Spraying herbicide
Permitting scientific activities	• Installing research plot monumentation, such as rebar stakes or nails • Installing most scientific instrumentation • Collecting a limited number of voucher specimens with no impact on species distribution or abundance	• Installing enclosures or exclosures • Installing instrumentation that disrupts the movement or behavior of plants, or fish and wildlife • Capturing, collaring, and releasing wildlife
Building system trail	• Routing a trail around a rockslide • Building a bridge across a stream to prevent stream bank erosion • Installing a small section of corduroy across a wet area • Installing in water bars or building rock-cribbing	• Routing a trial through an area of sensitive alpine butterfly habitat • Building a large amount of trial to go around a section of river or cliff • Building a trail that requires extensive earth movement or tree cutting
Obliterating non-system trail	• Piling vegetation or rocks at the beginning and end of trail sections that cut a switchback	• Obliterating a large section of non-system trial that requires extensive earth movement

Action	Likely Not a Trammel	Likely a Trammel
Restoring campsites	• Restoring a single, isolated campsite • Restoring a number of campsites that do not require disrupting the soil or vegetation in the surrounding area	• Restoring a number of campsites that requires moving a significant amount of soil or number of plants in the surrounding area
Removing hazard trees	• Removing one or a few hazard trees that threaten designated campsites or that are alone a trail	• Removing all of the hazard trees over a large area

NPS Photo, P. Palma

For more information about wilderness management in the National Park Service, including inquiries about wilderness management guidance, please contact the NPS Wilderness Stewardship Division at wilderness_stewardship@nps.gov or visit www.nps.gov/wilderness.

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