December 1, 1999
--Draft For Review
SMP prepared by J.H. Lynch

SOUNDSCAPE PRESERVATION AND NOISE MANAGEMENT PLAN

FOR

BISCAYNE NATIONAL PARK

TABLE OF CONTENTS

TABLE OF CONTENTS

i: Purpose and need for the plan 1

ii: Introduction 2
Enabling Legislation 2
Park Boundary 3
Park Location Map 4
Relationship to Other Park Planning Documents..... 5
Natural and Cultural Resource Setting 6

iii: The Management zoning of Biscayne National Park 9
Description, Visitor Activities and Objectives for Management 9
Protected Natural Area Subzone 9
Outstanding Natural Feature Subzone/Historic Preservation Zone 10
Natural Environment Subzone 10
Development Zone 11
Special Use Zone 12
Management Zone Map 13
Definitions 14

iv: Characteristics of the Natural Ambient Sound Enviroment 15
Natural Ambient Sound Environment Description 15
Human Impacts to Soundscape Resources by Site Location 17

v: Baseline Information (quantitative) 15
Baseline Natural Ambient Soundscape Information 21
Review of Previous Noise Measurements 21
Baseline L90 Map 22
Sound Resource Indicator 23
Recommendations-Knowledge Gaps

vI: management considerations 24
Issues and Concerns associated with management and control of noise 24
Vistor Experience 24
NEPA Compliance
Homestead Air Force Base (SEIS)
Miami International Airport
Scientific Acoustic Research
Biologically Sensitive Zones
Culturally Sensitive Zones
Program Funding and Example Project Statement

Management Matrix

TaBLE OF CONTENTS cont.

vII: Management actions
Goals and Objectives
Phased Approach Concepts
Strategies for Noise Management
Table 4 Noise Issues Explored 35
Alternative Approaches to Meet Goals and Objectives
Management Matrix v:

vIII: Monitoring Plan
Concepts Regarding the Measurement of Noise 34
Natural Ambient Sound Measurement
Observer-Based Monitoring 35
Unattended Monitoring 36
Sampling Strategies
Objectives for On-going Monitoring 37
Site Selection 38
Table 1 Typical Sources of Sound 38
Table 2 Acoustic Zones 38
Table 3 Site List and Temporal Variability 39
Chart 1 of Monitoring Site Locations

Appendicies

Appendix A: A-

Appendix B: Resource Management Plan Project B-
NRPP PROJECT STATEMENT B-

appendix c: List of Related Resource Action Plans C-

appendix d: List of Federal Laws, Regulations and Guidelines D-

Appendix E: sUMMARY OF pUBLIC SCOPING MEETINGS

Appendix f: List of Related Action Plans F-11

appendix g: Laws, Regulations, and Orders G-11

December 1, 1999
--Draft For Review
SMP prepared by J.H. Lynch

Soundscape Management Plan for Biscayne National Park

Purpose and Need for the Plan

Preservation and restoration of natural ambient sounds within the National Park Service as a whole and within Biscayne National Park in particular are among the foremost challenges in the protection of park resources. Biscayne National Park's awareness was raised concerning noise management in 1997, as the proposed transfer of portions of the former Homestead Air Force Base for development as a major commercial airport caused immediate concern about the possible impacts of aircraft noise. Eventually this led to broader questions about the relationship of *all* sounds, natural and human-caused, to the purposes for which Congress created Biscayne National Park.

The National Park Service (NPS) describes the natural ambient sound environment as an intangible natural resource that is important to protect in units of the National Park system. Just as parks contain many tangible features, such as animals, plants, geological features and archeological sites, they have intangible qualities as well. These qualities include such aesthetic values as solitude, space, clear night skies and a sense of history[1]. Both NPS Organic Act (as amended)[2] and NPS policy identify natural sound environments or "soundscapes" as a park resource and value worthy of protection. Park legislation, park management documents and national directives elaborate on the preservation and protection of Biscayne National Park's intangible and tangible values, including the soundscape.

Park managers decided that this Soundscape Management Plan would best meet this challenge as a stand alone implementation planning document. The purpose of the Soundscape Management Plan is to characterize the existing soundscape, discuss the evaluation and mitigation of intruding noise sources, and present alternatives for preserving and restoring the soundscape in areas found to have excessive noise intrusions.

---

[1] NPS-77
[2] NPS Organic Act

Introduction

The soundscape of Biscayne National Park is something to be treasured, not only because visitors enjoy it, but also because it is a resource in and of itself. Biscayne National Park's goal is to strive to preserve the natural quiet and the natural sounds associated with the physical and biological resources of the parks. The sounds of wind rustling palm trees or the waves rippling on the coral shoreline, frog calls that are essential for successful breeding and bird calls that help define their territories, are all protected elements that make up the park's soundscape. In considering natural ambient sounds as a resource, the ability to hear clearly the quieter intermittent sounds of nature, for extended periods of time will be an important consideration in Biscayne's soundscape management.

The deterioration of soundscape quality has been and is a matter of concern in the National Park Service[3]. This plan addresses noise impacts to the soundscapes and details management strategies based on the laws, policies, and plans that govern how we currently manage this park. Management actions will include minimizing noise intrusions, restoring degraded soundscapes to the natural ambient condition wherever possible and protection of natural soundscapes from degradation due to human-caused noise.

Biscayne National Park's goal is that in any given part of the park, the soundscape will complement the way the resources are being managed at that location, contribute to the purpose for which the park was created, and collectively support the greater park ecosystem. Ultimately the soundscapes throughout this national park will consist of a mix of natural and human-caused sounds. The types, frequencies, magnitudes, and duration of human-caused sounds considered acceptable will vary throughout the park, being generally more tolerable in developed areas and significantly less in undeveloped areas. As indicated, this plan will call for action to be taken to prevent or minimize all noise that, adversely affects the natural ambient soundscape, other park resources or values, or exceeds levels that have been identified as acceptable to, or appropriate for, visitors' uses.

This is plan is intended to be evolutionary. It is anticipated that as additional noise data are acquired, research continues, and the results of other noise mitigation programs are assessed, that specific needs of soundscape management will encompass the new knowledge and this planning document will be updated accordingly. Soundscape management is, in many ways, in its infancy. Great strides are being made in the acoustic sciences as they relate to ecosystem health. In addition, more data will be analyzed and collected at Biscayne National Park which will require updating figures that contain field data, the summary charts along with monitoring protocols as they will be fine tuned over time. The list of technical references in the acoustic sciences will be expanded as research articles are completed.

[3] The Nature of Sound NPS, 1999

Enabling Legislation

Biscayne National Park, located on the southeastern edge of South Florida where the Miami metropolis meets the Florida Keys, was established as a national monument in 1968. In 1980 it was enlarged to 181,500 acres and re-designated as a national park. Exact details, as well as copies of the documents can be found in the Park's General Management Plan.

When reviewing the various documents that compose the administrative history for the founding of Biscayne National Monument, and later re-designated a National Park, it is obvious that the initial drive to establish the park was protection of the natural resources. In both the 1968 and 1980 enabling documents, Congress charged the National Park Service to *preserve and protect for the education, inspiration, recreation, and enjoyment of present and future generations a rare combination of terrestrial, marine, and amphibious life in a sub-tropical setting of great natural beauty.* Although not stated directly, it can be inferred that Congress intended the natural ambient soundscape a natural resource within the Park to also be preserved and protected.
The park is further bound by a series of regulations and directives that mandate that the resources within Biscayne National Park be protected. These include .....A review of the directives that have direct application to Biscayne National Park can be found in Appendix.....

The General Management Plan[4] for Biscayne National Park mandates to the superintendent that, "Noise levels will be monitored to establish baseline data for assessing the impacts of air traffic and other noise on park wildlife and the visitor experience". Continued monitoring is an essential part of the park's Soundscape Management activity that will build on current knowledge of the park's natural ambient environment.

Park Boundary

Biscayne National Park is located south of the City of Miami (Figure 1). The northern boundary of the Park is adjacent to the southern extent of Key Biscayne, and 22 miles to the south, the southern boundary is located near the northern extent of Key Largo. The western boundary of the park is roughly defined by the landward extent of a mature re mangrove (*Rhizophora mangle*) forest which forms a narrow band, 100-2000 feet wide, along the western shoreline of Biscayne Bay. The eastern boundary, located approximately 14 miles to the east, is defined by the contiguous 60 foot (10 fathoms) depth contour. In all, 180,000 acres or 281 square miles (728 square kilometers) of mostly submerged land are under protection of the Park [verify numbers].

[4] Biscayne National Park, General Management Plan, 1993

Park Location Map

Relationship of this Plan to Other Pertinent Park Plans

Natural and Cultural Resource Setting

Biscayne National Park is marine park. Emergent land represents only five percent of the total are within the boundaries, the rest of the Park is submerged beneath warm oceanic and estuarine waters. The Park encompasses a system of complex communities of marine and terrestrial habitats that are in relatively pristine condition.

In general, the Park can be divided into three major environments: coral reef, estuarine (Biscayne Bay), and terrestrial. The coral reef tract lies due east of the keys and comprises the northernmost extension of living coral reefs in the United States. A west to east profile across the reef tract reveals two major zones: the back reef and outer reef. Intermittent patch reefs, sea grass beds, and sand lenses make up an irregular pattern of shallow banks and relatively deeper channels within the back reef zone. The outer reef forms the seaward edge of the coral reef, and usually consists of a series of terraces that increase in depth to the east.

The estuarine system of the Park comprises the lower 1/3 of Biscayne Bay. The benthic communities in this environment consist of sea grass beds and hard bottom communities. In general, the sea grasses dominate the western portion of this system, and the hard bottom communities are mostly found along the eastern portion. Within the Park, the average depth of the bay is eight feet; maximum depth is 13 feet. Natural history shows us that this has not always been a salt water bay; during earlier stages of lower sea levels, most of what is now bay was terrestrial or a combination of terrestrial and freshwater marshes.

The terrestrial system consists of a narrow fringe of mangrove shoreline located along the Park's western boundary and 42 keys or islands.). The keys range in size from just under 2 to over 2,000 acres. The total land area within the Park encompasses 9,075 acres (mangrove shoreline, 4,825 acres; islands, 4,250 acres). With the exception of the Arsenicker keys (located at the extreme southern end of the bay), these islands form a natural north-south barrier between Biscayne Bay and the coral reef platform. The keys contain various habitats including hardwood hammocks, mangrove wetlands, sandy beaches, and rocky intertidal areas.

The lands and submerged bottomlands of Biscayne National Park are rich with the physical remains of archeological resources that describe the cultural history of southern Florida and the Florida Keys. Submerged archeological sites provide an array of shipwrecks and other representations of maritime casualties that demonstrate the international maritime heritage. Partial survey of the submerged lands identifies over one hundred loci containing archeological remains. The earliest identified submerged site is from the mid-18th century. Since historical records document that early European exploration of this region began in the early-16th century, it is quite feasible that submerged maritime archeological remains are to be found that will predate the mid-18th century. The geography and geology found in Biscayne National Park has presented a series of natural factors, the Florida Reef, the Gulf Stream, narrow, shallow channels, and hurricanes, that when combined have caused many a ship to founder and wreck here. Since the occasion of European contact with the American continents, the Florida Keys (Biscayne National Park) have been a converging point for maritime trade routes from Europe, and Northeast American

continent, to the Caribbean, Central and South America, and the Gulf of Mexico. These shipwrecks, as well as other representations of maritime casualties, are now submerged archeological sites within the park and are listed in the National Register of Historic Places as an archeological district (Offshore Reefs Archeological District).

The islands or *keys* of Biscayne National Park include numerous prehistoric archeological sites. The earliest site found is on Sands Key that suggests intensive settlement by 1000 AD Immediately adjacent to the park on the mainland is the Cutler Fossil site (8000 B.C.) which gives suggestion that the lands and waters of Biscayne National Park have the potential for archeological find from even earlier dates than presently found.

Boca Chita Key Historic District, a National Register listing, consists of ten historic structures as well as the ruins of several others; they represent typical resort architecture for the Miami area in the 1930s. Elliott Key includes an archeological district, the Sweeting Homestead, which is the archeological remains of the first pioneering homestead on these keys during the end of the 19th Century. Prehistoric and historic archeological sites and architectural ruins are present on other keys within the park as well.

Park Management Zoning[4]

Description, Visitor Activities and Objectives for Management

Natural Zone- Protected Natural Area Subzone

The Protected Natural Area subzone includes lands and waters that are unusually fragile or ecologically significant. The management objective is the perpetuation of significant natural values and human intrusion is either prohibited or minimized.

Mangrove Fringe

The mainland mangrove shoreline located between Convoy Point (for further information see Development Zone) to Black Point are placed in the Protected Natural Area subzone (see map). The mangrove community provides wildlife habitat, including important bird rookeries, and is also critical to various marine populations of fish. This is an area known to be home of the sea otter and endangered manatee.

Over most of the shoreline, dense vegetation overhanging the water's edge bars human entrance and gives water-bound visitors a sense of what the southern Florida coast was like prior to development. Canoeing, bird watching and fishing occur along the shoreline.

Old Rhodes Key

The keys, tidal creeks and shallow waters between Caesar's Creek and the southern boundary of the park are placed in this subzone (see map). In this area of the barrier island system, the line of keys widens but is more frequently broken by narrow, winding creeks and lagoons. This area includes pristine uplands and estuarine communities.

It is fairly isolated from other areas of the park and is representative of a backcountry experience. Visitors on sailboats, flat boats, kayaks, and canoes enjoy the areas remoteness. A feeling of mystery prevails in these constricted waterways, and although a glimpse of pirates is anticipated around every curve, only wildlife is encountered.

Arsenicker Keys

The four Arsenicker Keys and the surrounding submerged lands and waters up to 1,500 feet from the shoreline are placed in this subzone (see map). These keys at the southern boundary of the park provide habitat for bird rookeries and the endangered southern bald eagle.

[4] Biscayne National Park, General Management Plan, 1993

Natural Zone

Outstanding Natural Feature Subzone/ Historic Preservation Zone

Lands and waters in this subzone possess unusual intrinsic values or uniqueness and are managed to conserve those values. Conservation of resources is emphasized accompanying public appreciation and interpretation.

Reef Tract

The reef tract from the eastern edge of Hawk channel to the park's eastern boundary at the 60-foot contour is in this subzone (map). The offshore and patch reefs in this tract are the northernmost living coral reefs in the United States. In and around the living reefs, a huge and diverse population of fish and other marine creatures abound, as well as the remains of historical sunken ships (the reef tract is jointly classified as a historic preservation zone). Because of the nationally significant concentration of historic shipwrecks on the reef tract, it is placed in the historic preservation zone. The shipwreck between Elliot Key and Hawk Channel is also placed in this zone.

The coral reef track is a favorite destination for park visitors wanting scuba dive and snorkel. Sailing, motor boating and fishing also occur within the area.

Natural Environment Subzone

The entire park not otherwise zoned belongs in this subzone (map). This area is primarily managed to conserve natural and cultural resources.

Biscayne Bay

Within the clear shallow waters of the bay, dense beds of turtle grass and patches of algae, sponges, and soft corals nurture a diverse collection of marine and estuarine life. The bay is an essential nursery for spiny lobster, pink shrimp, and several gamefish and the rich biotic community supports important commercial and sports fisheries.

The sheltered water east of the Intercoastal Waterway (ICW) supports a wide range of recreational uses, including sailing, motor boating, water-skiing, swimming, snorkeling and fishing. The bay's broadness and shallowness make it excellent for anchorage as well as adventure and discovery.

Development Zone

The zone encompasses Convoy Point on the mainland, the southwest portion of Adams Key, the Elliot Key Harbor and university dock areas of Elliott Key, and much of Boca Chita. This zone is managed fort he provision and maintenance of park development to serve the needs of management and visitors.

Convoy Point

Convoy Point located in south Dade County, is the official land side entrance to the park. It provides non-boating visitors the ability to experience the park first hand. The Visitors Center interprets the various areas within the park and offers sweeping views from the second floor veranda. Benches and rocking chairs allow visitors peaceful moments to themselves and nature. The boardwalk and jetty give visitors to the opportunity to walk, picnic, fish, and watch birds. Contemplative recreation, picnicking, canoeing, and wind surfing occur at Convoy Point. Daily diving/snorkeling reef trips and interpretive glass-bottom boat tours are available through the concession. Convoy Point is surrounded by the mangrove fringe and near shore, shallow bay. Manatees, otters and many species of birds and fish may be observed in the area.

Elliott Key

Elliott Key is the largest of the natural barrier islands. The area offers visitors a wide range of uses including: boat docking, picnicking, interpretive trails, interpretive exhibits, swimming, wading, snorkeling and designated overnight camping. Interpretation provides contact with the island resources, as well as, with the human history of the barrier system.

Boca Chita Key

Boca Chita Key is a north-central point of the barrier system. The island is Biscayne National Park's most popular destination for local boaters. Docking, picnic areas and restrooms are available for visitors. Camping is allowed on a first come, first serve basis, in designated areas.

Special Use Zone

These areas include easements, special use permits for private lease, and primary corridors for boat traffic. Management of these areas.....

Transportation Subzone

The Intracoastal Waterway through the bay, the marked Hawk Channel between the keys and the reefs, and the two channel easements serving Homestead Bayfront/Convoy Point and Black Point are placed in the transportation subzone, since they are primary corridors for boat traffic. Frequent boat traffic along the ICW is common.

Commercial Subzone

The channel easement serving the Florida Power and Light facilities at Turkey Point is placed in this subzone. Barges providing fuel to the power plant use this channel.

Utilities Subzone

The overhead power lines from Turkey Point Powerplant and five drainage canals through the mainland shoreline are in this subzone. Moody, Mowry, and Florida City canals, and a short section of the salinity barrier are under the jurisdiction of the South Florida Water Management District. Military Canal is under a special use permit for Homestead Air Reserve Base.

Private Residential Subzone

Three areas currently in this subzone will eventually be reclassified following expiration of special use permits or reservations. Stiltsville... The Tannelhill property, near the northern end of Elliott Key, is under a renewable special use permit, and the Jones residence on Porgy Key is a life estate.

Management Zone Map

Definitions

A-weighted decibel: A unit of sound pressure that adds together the sound energy at all frequencies in a way that is intended to correspond to how the human ear hears sounds, de-emphasizing low-frequency and high-frequency sound energy, while emphasizing sound in the frequency range important for understanding human speech[5]. Abbreviated dBA.

Acoustics: The science of sound, including the investigation of the causes of sound and the properties that affect its audibility and fidelity[5].

Background Sound Level: That level of non-specific sound that exists in the absence of identifiable human-caused sound. This is the sound level that should be measured in those situations where it is not possible to measure the natural ambient sound level with certainty. This level is frequently estimated using a statistic called L90-the sound level that is exceeded 90 percent of the time.

Noise: loud, discordant, or disruptive sound inappropriate to park purposes, which is caused by human activities.

Natural Ambient Sound Level: The natural sound conditions in a park, which exist in the absence of any human-produced noises. In a noisy environment the natural ambient sounds may be masked by other noise sources.

Sound: an oscillation in pressure, stress, particle displacement, particle velocity, etc. in a medium such as air.

Soundscape: The surrounding sonic environment that is experienced by hearing, rather than by seeing. Soundscapes may include both mechanical and natural sounds, and may vary in their character from day to night and from season to season[5].

Metrics

Leq = the energy-average sound level

Lx = the sound level exceeded x-percent of the time.

Soundscape Characteristics

[5] Effects of Mechanical Noise and Natural Sound on Visitor Experiences in Units of the National Park System by Dr. James Gramann, Vol.1, number 1, Winter 1999

Natural Ambient Sound Environment of Biscayne National Park

The natural sounds that make up the ambient sounds environment or soundscape in each management area of the park consist of a combination of one or more of the following; wind, insects, other animal vocalizations, water, thunderstorms and vegetation. Several studies have found that the ambient sound levels vary with wind according to the local ground cover[6]. The natural sounds are related to the type of nearby vegetation, the population of wildlife that are drawn to the vegetation, and the interaction of the wind with the vegetation.

The character of the sound level or loudness of wind flowing through the foliage of mangrove trees and other vegetation depends primarily on the wind speed and sometimes on wind direction. During April-October the wind is typically from the south/southeast. The wind is usually calm during the night and early morning (less than 5 miles per hour) with wind speeds increasing during the day (5-15 miles per hour). The open water and the keys can be fairly windy at times reaching speed of 20 miles per hour. The months of June-October are also noted for a high potential of hurricanes winds can be in excess of 50 miles an hour or more.

During November-March the wind is typically out of the east/northeast. Fronts travel through the area approximately every 5-7 days, and winds can vary from 10 to 20 miles per hour as the winds swing from northwest around to northeast.

Lapping water on the shore and through mangrove roots is another characteristic element of the soundscape. The sound level or loudness primarily depends on the tides, wind speed and wind direction. The tides rise and fall slowly in this area as the bay flushes in the northern end of the park from Biscayne Channel and the Safety Valve while the southern end flushes through Barnes Sound. As previously noted the winds are stronger during the winter months therefore water sound levels increase.

Animal sounds including insects, amphibians and bird calls are common in the Park. Bird rookeries include many species of herons and egrets, the endangered wood stork and the magnificent frigatebird. In addition cormorants, ospreys, bald eagles and terns vocalize. Tree frog calls can be heard beginning in late spring and continuing through early summer. The sounds of mosquitoes, katydids and other insects can be heard all of the year, particularly in early spring and continuing into the summer months. Thunderstorms and heavy periods of rain are frequent characteristic sounds especially in the summer months. During the winter months weather fronts come through the area. Thunderstorms are common elements that make up the soundscape throughout the year.

Many other natural intermittent sounds can be heard in the park that can inspire humans with a feeling of peace and tranquility. Along the mangrove fringe you can hear the occasional slap of a grouper's tail, a snort of a West Indian manatee, the call of an osprey or a mangrove cuckoo. While diving or snorkeling on the reef visitors can hear parrot fish feeding on coral or the sound of shrimp clicking their claws together. While sitting on a boat near the reef one can hear a sea turtle take a breath, a call of a seabird, or even a slap of a dolphins fluke.

---

[6] The Soundscape in South Florida National Parks by Wyle Research Laboratory, 199

Scientific Acoustic Research

Scientists are conducting experiments to improve the understanding of how the sounds of wildlife compose a soundscape. These efforts are expanding the our knowledge of the natural soundscape in terms of ecosystem health by including acoustical characteristics of a place, in addition to its biological, physical and social characteristics.

When qualitatively describing the soundscape of a place one needs to keep in mind that there are other layers of quantitative information that will add to the depth and quality of the understanding of natural sounds at the park. Exciting research in the field of bio-acoustics (bio=life, acoustic=sound) has indicated that the health and age of an ecosystem can be inferred by the sound orchestra or "biophony" of a niche made up of the wildlife and vegetation of that microhabitat or biome[7]. In time this research may help us define soundscape quality in terms of bio-diversity and niches. Research in the park shows a diurnal variation in the sound levels in the park and expands our understanding of our soundscape[7]. Future monitoring efforts will look at seasonal variations, underwater sound monitoring, and fine tuning methods of measuring sound on the open water.

9

[7] The Niche Hypothesis: How Animals Taught Us to Dance and Sing by Dr. Bernie Krause

Human Impacts to Soundscape Resources (Qualitative Description)

The park noise management issues and concerns can be categorized into three areas; a) noise related to park operations and concessions, b) visitor and commercial activities, and c) other intruding sources from outside the park. Noise concerns have been identified through both an internal Park[8] and public scoping process[9]. Scoping meeting participants were asked about impacts to their quality of experience at BISC. Although not representative of all visitors, they have provided a diversity of opinion on the issue. These included noise from idling tour buses, jet fly-overs, and audio devices at mooring areas. In addition, opportunities for quiet moments and hearing the natural sounds were mentioned on comment forms as important indicators of experience quality. Identification of noise sources impacting the park soundscape or the experience that the park is intended to provide are described below by area within each management zone or subzone.

Development Zone

Convoy Point

Convoy Point is the official land side entrance to the park. The new Visitor Center interprets the various areas within the park and offers sweeping views of the bay from the second story veranda. Benches and rocking chairs allow visitor peaceful moments to themselves and nature. The boardwalk and jetty also permit visitors to walk out along Biscayne Bay. Recreation activities at Convoy Point include, fishing, picnicking, wildlife viewing, windsurfing and canoeing. Daily diving/snorkeling reef trips and glass-bottom boat tours are available through the concession. Convoy Point is surrounded by the mangrove fringe and the near shore shallow bay. Birds, West Indian manatees, otters, and fish may be observed in the area.

Statistics gathered indicate that _____ visitors come to enjoy the park grounds and picnic and fishing areas. Some of the more common noise from visitor parking lots includes idling busses, slamming car doors, "boom boxes" and car stereos. Other sources of noise include congregations of visitors using the picnic area and jetty.

Visitor Center statistics indicate that _____ visitors come to the VC where they can enjoy interpretive programs, look at park displays, and get park information. In the Visitor Center itself the mechanism that runs the lights for the displays has been identified by park staff as an intruding offensive noise. Noises identified in the vicinity of the visitor center include; the air conditioning units located outside the building, the noise of the concession boats starting up, idling and running in the marina, and CB radios on interpretive boats, state/federal law enforcement boats, and concession boats in the marina. The use of motorized maintenance equipment is also a noise concern especially during hours of heavy public visitation.

Identification of Noise Sources in the Soundscape

- air conditioner

---

[8] Internal Scoping Process BISC staff meeting January, 19
99

[9] Public Scoping Meetings June , 1999 and Public Comment peri

- idling busses
- slamming car doors
- audio equipment
- maintenance machinery
- park communication radios
- concession boat

Elliott Key

Elliot Key is the largest of the natural barrier islands. The area offers visitors a wide range of uses including: boat docking, picnicking, interpretive trails, interpretive exhibits, swimming, wading, snorkeling and designated overnight camping. Interpretation provides contact with the island resources, as well as, with the human history of the barrier system. The generators located on the island to run electricity have been identified as a noise issue. In addition, some maintenance activities on the island may intrude on the visitor experience as a result of the park's duty to maintain the grounds and facilities. The use of boat generators at the Elliot Key Marina is a noise concern. Sands Cut and the University Dock area provide boat docking and anchorage for visitors. Noise from audio devices and generators from visitors on boats gathering mostly on weekends and holidays has been identified as a noise concern.

Identification of Noise Sources in the Soundscape

- boat generators
- air conditioner
- audio devices
- generators
- maintenance machinery

Boca Chita Key

Boca Chita Key is a north-central point on the barrier island system. The island is Biscayne National Park's most popular destination for local boaters. Docking, picnic areas and restrooms are available for visitors. Visitor statistics indicate that visitation in the winter is significantly higher _____ than in the summer_____ when temperatures are extremely high and mosquitoes are frequent pests. Boca Chita Key's most well known feature is the ornamental lighthouse with its viewing platform. Camping is allowed on a first come, first served basis, in designated areas. Quiet hours are in effect from 10:00p.m to 6:00a.m. The noise from boat generators in the marina, as well as generators that provide power on the island have been identified in the scoping process as noise concerns. In addition, some maintenance activities on the island may intrude on the visitor experience as a result of the park's duty to maintain the grounds and facilities.

Identification of Noise Sources in the Soundscape

- boat generators
- air conditioner
- audio devices
- generators

- maintenance machinery

Adams Key

Similar to Elliott Key the soundscape is influenced by an operating generator that provides power for the NPS residences on the island. This area is in close proximity to Caesar's Creek Channel, which is a major channel for boat traffic to and from the open ocean.

Identification of Noise Sources in the Soundscape

- boat noise
- generator

Protected Natural Area Subzone

The keys, tidal creeks and shallow waters between Old Rhodes Key and Totten Key are located in the southern section of the barrier system. It is fairly isolated from other areas of the park and is representative of a backcountry experience. This protected natural area is in close proximity to Caesar's Creek Channel, which is a major channel for boat traffic to and from the open ocean. The noise from motor boats is a noise concern in this area especially for biologically sensitive wildlife species.

Identification of Noise Sources in the Soundscape

- boat noise

Natural Environment Subzone

The Central to Eastern Biscayne Bay is important from both a natural resource and visitor use perspective. The bay is an essential nursery for spiny lobster, pink shrimp, and several gamefish and the rich biotic community supports important commercial and sport fisheries. The bay's broad and shallow attributes make it excellent for anchorage as well as adventure and discovery. The bay's waters are remarkably clear in spite of the constant threat of pollution from mainland industrial, agricultural, and urban sources. Noise concerns in this area to date are identified in general terms, as more information is needed to identify noise impacts from underwater impacts to marine mammals and impacts on visitors.

Special Use Zone

Frequent boat traffic plies the center of the bay along the Intracoastal Waterway (ICW), and the sheltered water to the east supports a wide range of recreational uses, including sailing, motor boating, water-skiing, swimming, snorkeling, and fishing. Human generated sounds in this area of the park are of concern as they may affect more sensitive zones and subzones throughout the park.

Outstanding Natural Feature Subzone/ Historic Preservation Zone

Noise concerns in the area of coral reefs include the quality of the visitor experience while enjoying fishing, snorkeling and SCUBA diving activities as well as resource concerns for the integrity of the shipwreck sites and the associated biota. Relatively new research shows underwater noise can have a detrimental effect on marine biota particularly marine mammals[10]. Cumulatively, the effect of intrusive noise combined with other environmental stressors can cause a degradation of resources and visitor enjoyment.

Nature and Scope of Aircraft Overflights

Noise and vibration resulting from aircraft overflights can adversely affect park resources and values and interfere with visitor enjoyment. BISC managers have identified noise from military overflights from the nearby Homestead Air Force Reserve Base (HARB) and commercial passenger aircraft as a major concern in terms of resource protection and the quality of the visitor's experience. At any time the entire park may be affected by noise from existing air traffic from three nearby airports (Miami International Airport, Kendall-Tamiami Executive Airport and Homestead General Airport) this includes general aviation and passenger planes. Measured sound level show that aircraft noise levels can protrude well above the measured natural ambient levels. The type of aircraft, the number of flights per day, the location of the flight corridors, and the altitudes of flights influence noise levels. Of immediate concern is the potential for increases in numbers of aircraft overflights from the

od

[10] Marine Mammals and Noise by W.J. Richardson et al, 199

expansion of the already existing MIA and/or the proposed conversion of parts of the Former Homestead Airforce Base to a commercial airport (see pg___).

During the Soundscape Plan scoping session park staff identified the mangrove fringe extending north from Convoy Point consisting of the mainland shoreline boundary of the park as directly threatened by noise from low-flying aircraft. Several rare, threatened and endangered terrestrial and aquatic species utilize this area for nesting, breeding, feeding and raising young. Similarly this area is important feeding and roosting habitat for native and migratory birds. This area is managed as part of the **Protected Natural Area Subzone** and is one of the most biologically sensitive areas in the park (see pg__ for further discussion).

The park is currently being reviewed at the regional level to be nationally recognized as a Cultural Landscape[11]. During all historical periods on the keys human lifestyles were influenced by water, its isolation, and its mode of travel and commerce before mechanization. The sound and sight of aircraft activity impinging on the overall sense of the maritime cultural landscape was identified as an impact to the aesthetic cultural resources of the park. Noise vibration affects on historic structures located in the **Developmental Zone** on Boca Chita Key were identified by park staff due to the potential for structural damage (see pg__for further discussion).

From a historic perspective, military overflights have been an issue of concern for the three NPS sites in south Florida. Disruptive, low level, military training flights, take-offs and landings (operations) from Homestead Air Force Base have been formally and informally recorded. After Hurricane Andrew, the base was downsized to an Air Reserve Base and the frequency of flights significantly dropped. Although the numbers of flights declined, operations originate from only 3 miles west of the park and at times significantly affect the park soundscape.

The NPS previously focussed on the issue of aircraft overflights, and particularly overflights by businesses providing commercial air tours of NPS sites. At this time it is not certain what the impact is at BISC. The park managers would like to get more information on commercial air tour overflights including the numbers of operations and frequency of flights.

Identification of Noise Sources in the Soundscape

- Military overflights
- Commercial flights
- general aviation
- aircraft tours

-Add information sheet on PWC

5

[11] Cultural Landscape is defines as a geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values. Cultural Resource Management Plan for BISC, in draft 19

Baseline Natural Ambient Soundscape Information

The Soundscape in South Florida National Parks

Recently completed, "The Soundscape in South Florida Parks" by Wyle Research Laboratory, August 1999 provides a detailed reanalysis of the field data gathered to date (see below) and developed general procedures for measuring the natural ambient soundscape. The primary goal was to take sound measurements in South Florida parks (BISC, BICY, EVER) to refine acoustical metrics based on manned and unmanned field data to describe the natural soundscape of a park.

The sound levels for the season of the study exhibited a diurnal pattern, with the highest sound levels occurring mostly at night and the lowest sound levels during the days. All of the field studies thus far were measured during August, September, or October, future monitoring will look at seasonal variations in sound levels. The higher sound levels at night correspond to the increase in insect activity, the sound levels rise and remain mostly constant over the nighttime period, which would be consistent with insect sounds. Conversely intruding transient sound events increased during the day and decreased at night. This makes intuitive sense as well as visitors and human generated noise increases during the day light hours.

Studies in the past have used various metrics to describe in qualitative terms the baseline sound level at parks Service-wide. The Wyle report helped us refine our metrics and standards concerning our baseline data. Rather than using the Leq or the L50 to indicate our baseline levels, the report indicates the L90, the sound exceeded 90% of the time, provides an accurate assessment of the natural background sound levels and furnishes a solid basis for determining intrusive event threshold levels (see Sound Resource Indicator pg __).

For the sites monitored in south Florida, the A-weighted sound levels due to natural sources were reasonably consistent over the region for the time period studied. The average 24-hour L90 for all the sites was 33 dBA. Quantitatively, the protected shorelines were the quietest sites and the loudest sites were the dense forests. Characteristic zones were monitored to test the hypothesis that characterizing the natural soundscape of the south Florida sites could be accomplished based on acoustic zones. Representative zones included; open water, forest on a key, key shoreline, shoreline mangrove key and developmental zone. Wyle found no statistical significance in the differences in sound levels based on acoustic zones in the South Florida parks. The natural ambient soundscape is fairly constant over the park areas and that levels do not vary according to specific regions.

Review of Previous Noise Measurements:

Based on the information available three substantial studies during 1995-1998 have been conducted to characterize the sound environment is south Florida. The three studies are; 1) a study by Post, Buckley, Shur and Jerigan done in 1995 2) a study by Sanchez Industrial Design (SID) in 1997 and continued during 1998 3) a study by Volpe National Transportation Center in 1998.

The Post, Buckley Study was conducted by a contractor for Dade County. Data were collected over the three-day period of August 15-17, 1995. Ten sites were monitored for a period of 1 hour. Some of these sites were in or near either Biscayne National Park or Everglades National Park. No permit was sought from or granted by the NPS for these measurements and so the only information available to the NPS is from the contractor's report. Unfortunately only the summary of the data was reported. Without the original data sheets showing the type of ambient measurement made, the times of the day, and the exact locations of the measurements, this study is of little use.

Sanchez Industrial Design's study was funded by the NPS to collect measurements from both Biscayne National Park (BISC) and Everglades National Park (EVER), as well as at two points to the north of BISC in Biscayne Bay. A total of 32 one hour measurements were collected showing the noise levels and times for the natural ambient noise conditions and all intruding noises. Most of the monitoring sites were visited twice for two hours. A trained observer measured the data at 1-second intervals and identified the sound source that was heard at each instant in time. Emphasis was on separating periods of time in which only natural sounds were heard from periods of time in which human-caused sounds obscured the natural ambient conditions. The measurements were made during the September-October, 1997 timeframe at sites selected by park personnel for their resource values. Eight sites were selected with an additional two sites in the southern flight tracks of Miami International Airport, just north of BISC.

The Volpe study was funded by the Federal Aviation Administration (FAA), it was largely conducted during the period of August 10-20, 1998. The measurements were nominally for 3 hours periods. The Volpe reports the ambient data in a different way than SID. It includes all noises other than aircraft noise (i.e. mechanical intrusions from boats) as "ambient" resulting in higher reported sound levels than SID for the same conditions. The NPS has obtained the raw data and has prepared its own report (see above Wyle, 1999) that distinguishes the natural ambient environment, the resource to be protected, from other intruding noises. The NPS has been able to obtain the raw data from their acoustic logs and observer logs for more than 160 hours of monitoring.

Following the FAA's data collection effort the NPS funded SID to collect additional field data in 1998. The effort was two-fold to fill in some of the gabs at sites the FAA did not monitor and to test an additional technique. SID conducted 199 hours of measurements during the last few weeks in November. Six of the monitoring sessions were one hour long, observer-based monitoring efforts. The other 193 hours of data were collected using long-term unattended noise measurement equipment. The study demonstrated that unmanned monitoring provided a good picture of the hourly variations and diurnal dependence of sound levels in the park.

GIS Data Summary:

Appendix will list map, files, location, list
Include table or graph or map depicting noise measurements L90 Map

Recommendations-Knowledge Gaps

Past studies have included boat-based measurements. Due to water lapping on the boat hull it was suspected that recorded sound levels may be higher than if this influence could be removed from the data set. During the fieldwork in 1999 this was tested by placing a sound monitoring system on a shoal marker out in the open bay of the park. The overall comparison between the open water sites gathered from a boat versus a shoal marker did not show a difference in the sound levels as expected. The results indicated that there was no statistical difference in the data collected. However it is possible that wind on the microphone may be distorting the data set. Future monitoring protocols should test this hypothesis.

Additionally, there is no data to support the assignment of unique sound metrics (i.e. L90) for different areas of the park. No acoustical zones can be demonstrated in the data. This finding needs to be tested for other seasons of the year (data gathered to date were measured in the summer and early fall months). If this independence holds true throughout the year, then A-weighted values can be used to represent large areas of the park. The protected shoreline data had the lowest average L90 of 30 dB while the more intruded sites had the highest L90 of 37 dB. Based on the data gathered and analyzed in 1999, it is reasonable to extrapolate the average L90 parkwide (with the possible exception of the open water).

Resource Indicator

Quantitative

Understanding the difference between sound, noise, and the natural ambient sound environment is very important. A sound is usually defined, as a physical concept referring to the fluctuation in atmospheric pressure that is capable of producing an audible sensation in the ear. Natural sounds occur within and beyond the range of sounds that humans can perceive and can be transmitted through air, water, or solid materials. The natural ambient sound environment or soundscape includes the intermittent sounds of wind, water and animals in the absence of human caused intrusions. The soundscape is the aggregate of all the natural sounds that occur in parks, together with the physical capacity for transmitting natural sounds. In contrast noise is a disruptive human-caused sound which is inappropriate to park purposes.

National Park Service policy protects natural ambient sound environments as a physical concept, this implies that soundscapes can be managed in physical terms, for example restricting the intrusion of mechanical noises above a certain loudness or duration in protected natural areas.

Management Considerations

Issues and Concerns Associated with Management and Control of Noise

In developing an approach to preserve natural quiet it will be important to recognize the following information[12].

1. The soundscape is a resource for preservation within the National Park Service mandate.

2. The human auditory system is an excellent mechanism for determining the presence or absence of the natural ambient sounds in air. No readily available electronic device can duplicate human hearing for identifying audible sounds produced by non-natural sources.

3. The difficulty of preserving the soundscape is directly related to how quiet it is. If the natural ambient sound conditions are relatively loud, as along a beach with pounding surf, or near a waterfall, then intruding non-natural sounds will have to be comparably loud to be heard. On the other hand, in this park where it is there are fairly remote areas, even very quiet intruding non-natural sounds will be audible.

4. Humans are not always aware of sounds that are audible. Humans, when engaged in any number of activities, may have their attention focused on the activity and not be aware that a new sound has become audible.

5. Park settings can provide sound levels that are so quiet, there is no sound to be heard except that generated by the listener – the sounds of walking, breathing, and the heart pumping.

Visitor Experience

Many surveys show that quiet, solitude, and natural sounds play an important role in recreation experiences. Recreation area users consistently state that escaping noise and enjoying the sounds of nature are among the most important reasons why they visit natural areas. (Driver et al., 1991)

-Matrix
-Scoping etc.

98

[12] Based on recommendations from the Report on Effects of Aircraft Overflights on the National Park System, 199

NEPA Compliance

The National Environmental Policy Act of 1969,as amended, is the nation's charter for environmental protection. The National Environmental Policy Act establishes policy, sets goals, and provides means for carrying out the policy. Section 102(2) of the Act contains provisions to make sure that Federal agencies act according to the letter and spirit of the Act, including a provision to prepare a detailed statement on the effects for a proposed Federal action.

Homestead Air Force Base Supplemental Environmental Impact Statement (SEIS)

Shortly after Hurricane Andrew in 1992 the Homestead Air Force Base was slated for disposal. Miami-Dade County proposed that the base be converted into a commercial airport. In 1994 an environmental Impact Statement was completed by the Air Force based on this plan. In 1997, a decision was made to do a SEIS, completely revisiting the issues addressed by the original EIS and expanding the list of issues and alternatives. That SEIS process has been underway since that time. The lead agencies for the SEIS are the Federal Aviation Administration and the Air Force. The NPS, the Fish and Wildlife Service, and the Environmental Protection Agency are designated cooperating agencies.

The transfer of Homestead Air Reserve Base (HARB) and possible conversion into a commercial airport presents resource areas of concern to Biscayne National Park. The intrusive noises from the dramatic increase in air traffic (HARB lies about three miles west of BISC) has the potential to alter wildlife behavior and diminish the visitor's opportunity to experience a sense of solitude and tranquility. The present schedule calls for the process to be completed by early 2000. The SEIS is being finalized, which includes areas of concern for this park along with Everglades National Park and Big Cypress Preserve. Submitted statements outlining the possible impacts on recourses are in Appendix ___. The NPS has maintained that the Homestead SEIS must include all available noise studies, not just Homestead but Miami International Airport and any of the other airports and overflights affecting the Park. The reason for this is that the issue for the NPS is not Homestead in isolation but all of the aircraft noise affecting the Park and other sensitive sites in the region.

Miami International Airport (MIA)

The Environmental Impact Statement (EIS) for the proposed fourth runway at MIA included a reference to the National Parks to the south of MIA. Unfortunately the MIA EIS used an outdated version of the FAA's Integrated Noise Model and, in addition, their noise analysis was unacceptable to the NPS and their flight track analysis stopped at the boundaries of Everglades NP.

Biologically Sensitive Zones

The following areas contain species of concern relative to potential noise impacts over and near Biscayne National Park. These areas and resources are defined by the zones as classified in the parks General Management Plan (GMP) and the classification scheme as proposed to the NPS in the 9/12/94 "Report on Effects of Aircraft Overflights on the National Park System". Until more information is available, the 1994 Report to Congress recommended that the NPS use the levels of impact listed above to "trigger" actions to eliminate or reduce such impacts. In general, the NPS would regard situations consistent with "low impacts" to warrant monitoring, while situations that represent "moderate impacts" or "high impacts" would require pursuit of solutions.

Negligible impacts

- No species of concern are present and no or minor impacts on any species are expected.
- Minor impacts that do occur have no secondary (long-term or population) effects.

Low impacts
- Non-breeding animals of concern are present in low numbers.
- Habitat is not critical for survival and not limited to the area targeted for overflight use; other habitat meeting the requirements of animals of concern is found nearby and is already used by those species.
- Occasional fright responses are expected, but without interference with feeding, reproduction, or other activities necessary for survival.
- State or federal fish and wildlife officials express no serious concerns.

Moderate impacts
- Breeding animals of concern are present, and/or animals are present during particularly vulnerable life-stages such as migration or winter (includes foraging wading birds during nesting seasons).
- Mortality or interference with activities necessary to survival is expected on an occasional basis.
- Mortality and interference are not expected to threaten the continued existence of the species in the area. State and federal officials express some concern.

High impacts
- Breeding individuals are present in relatively high numbers, and/or animals are present during particularly vulnerable life-stages.
- Habitat targeted for overflights has a history of use by the species during critical periods, and this habitat is somewhat limited to the area targeted for overflight use; animals cannot go elsewhere to avoid impacts.
- Mortality or other effects (injury, physiological stress, and effects of reproduction and young raising) are expected on a regular basis. These effects could threaten the continued survival of the species.
- State and federal wildlife officials express serious concern.

In general the long-term effects of noise including aircraft overflights on wildlife are

not well understood. Reported animal responses vary greatly among species, and the ability of species to adapt to overflights also varies, along with seasonal and habit variation. The potential consequences form noise is thought to be greatest on breeding animals. Indirect effects on wildlife such as accidental injury, energy losses, habitat avoidance and abandonment are very difficult to detect, but some experts suspect that they do occur.

Human-caused noises intrusions (the frequency and/or duration) from any source may cause un-natural behaviors for the animals in and around the parks western shoreline (the Protected Natural Area). Affected behavior's may include but certainly not limited to flushing, displacement from roosting or nesting areas, disruption during foraging, reproduction, masking of vocalization and disrupting socialization.

This is particularly true for migratory and nesting birds. The National Park Service who participates in the Partner's In Flight Program has identified loss, fragmentation and quality of habitat for migratory birds worldwide as a serious problem. Biscayne National Park is an important area for birds to stop and rest/feed before they continue their journey.

(E) Endangered Species
(T) Threatened Species
(SC) Special Concern Species

1. Protected Natural Area.

This "fragile" resource area totals 7,800 acres in size and contains lands and waters of the Jones Lagoon and the entire length of the parks western shore (excluding Turkey and Convoy Points). The parks GMP defines this zone as ecologically "significant" for providing wildlife habitat.

Sensitive habitats include rookeries for several species of wading birds; roseate spoonbill (SC), little blue heron, reddish egret (SC), snowy egret (SC), tricolored heron (SC), white ibis (SC), black skimmer (SC) and wood stork (E).

The marine and amphibious environment provide habitat for such creatures as the American crocodile (E), the West Indian manatee (E) and the beaugregory-damselfish.

Additionally, the listed Schaus swallowtail butterfly (E) is currently being re-introduced near this habitat zone.

Based on criteria posed by Kroodsma and Webb (1994) any significant increase in noises in this most sensitive resource zone of the park will have moderate to high impact for the following species:

High- damselfish, American crocodile, Schaus swallowtail butterfly.

Moderate – West Indian manatee, roseate spoonbill, wood stork and other migratory birds (falcons, hawks, and passerines).

Low – Otter

2. Natural Environment Zone

These lands which include 118,000 acres of the park are managed to "conserve natural resources and processes while accommodating visitor uses and experiences which do not adversely affect the natural systems."

Sensitive habitats in this zone include bald eagle nests (Arsenicker Keys), and migratory bird routes (in spring and fall), brown pelican (T) roosts and white crowned pigeons (E).

Based on the rating criteria of Kroodsma and Webb any significant increase in noises in this management zone will have negligible to moderate impacts to the following species:

Moderate – bald eagle and some passerine migration routes.

Low - white crowned pigeon

Negligible – brown pelican

Culturally Sensitive Zones

The cultural resources in Biscayne National Park represent well over two thousand years of history and potentially could be as much as ten thousand years old. The resources are rich with archeological resources that portray an international maritime history; one which is located at the crossroads of international maritime trade and exploration since the arrival of the first Europeans. Just as rich are the prehistoric archeological sites remaining from the Paleo-Indians and later Tequesta Indians?

The park's resources consist of well over one hundred known archeological sites. Even though by nature of the environment the majority are submerged sites, almost every key within the park has terrestrial archeological sites, some which are the only preserved Tequesta Indian sites that remain in south Florida. The entire park is considered a Maritime Cultural Landscape and it is in the process of being formally documented for listing on the National Register of Historic Places. Boca Chita Key Historic District, a National Register listing, consists of ten historic structures as well as the ruins of several others; they represent typical resort architecture for the Miami area in the 1930s. Recently approved for listing on the National Register in 1997, this is a complex of ten stone and concrete structures built between 1937 and 1940 on Boca Chita Key. Mark Honeywell, founder of Honeywell Industries, built this complex of buildings as a private resort. They form a locally significant historic district on the north end of the island. All of the structures have exterior surfaces of quarry-faced Miami oolite limestone. The use of this limestone throughout the area visually unifies the structures and the district.

Elliott Key includes an archeological district, the Sweeting Homestead, which are the archeological remains of the first pioneering homestead on these keys during the end of the 19th Century. The preservation of Biscayne National Park's cultural resources provides a linkage to our human past that allows the public to appreciate the heritage of their nation and culture.

The park's cultural resources are extremely rich with examples of the international maritime heritage that has shaped the culture history of southeast Florida and the Caribbean region. A major concern to all of the park's cultural resources is the degradation that may occur to historic buildings and underwater archeological remains by the effects of vibration from aircraft and/or motor boats. The sound from aircraft activity can cause archeological resources, structures, and museum objects to vibrate. Depending on the character of the sound, the effects range from audible rattle, to items "walking" across surfaces, to fatigue cracking, and potentially to direct or indirect structural damage. Potential for impact depends upon the relationship of the aircraft overflight to the resource, the frequency of overflight, and the frequency-dependent responses of the resource to impinging sound waves[12].

Program Funding and Project Statements

DO-2 states that Implementation planning (i.e. Soundscape Management Plan "will be undertaken using all appropriate and available NPS and non-NPS sources of funds, equipment, services, and personnel. Implementation planning generally will be funded through project funding available for the specific type of project addressed by the plan. If project funds are not available, other sources will be sought. Within the NPS this includes park base, regional base, challenge cost-share program, construction project planning and the volunteers-in-parks program. Outside the NPS this includes collaborative projects with other federal agencies, state agencies, local governments, Indian tribes, scientific and educational institutions, and conservation and preservation organizations."

A soundscape monitoring project has been submitted into the Southeast Region's resource management plan database and into the PMIS database. The complete project statement can be found in Appendix ____. Projects in these databases include programming sheets summarizing the funded and unfunded project activities as well as staffing requirements and time requirements needed to complete assessments.

RMP- copy proposal and note that it has also been inputted in PMIS Appendix

NRPP proposal Appendix

Soundscape Inventory and Monitoring Program

The General Management Plan for BISC mandates to the superintendent that, "Noise levels will be monitored to establish baseline data for assessing the impacts of air traffic and other noise on park wildlife and the visitor experience". Continued monitoring is an essential part of the park's Soundscape Management activity that will build on current knowledge of the park's natural ambient environment. The data needs to provide a credible basis to establish the baseline sound levels for which future noise management decisions will be based.

Concepts Regarding the Measurement of Noise

Most of the work completed in noise monitoring has been associated with airport noise and focuses on pre-existing noisy urban environments. The criterion used by the FAA and the military to determine whether a proposed action is acceptable or not is based on "annoyance". "Annoyance" can generally be defined as, if a subject population is less than x percent annoyed by the noise, then the noise is "acceptable". The commonly used metric called DNL (Day-Night level) which allows for an adjustment for night time acceptable levels is inappropriate for NPS managed areas. Other metrics have been used by the FAA such as existing ambient noise levels (all noise present) and traditional ambient noise levels (noise levels without the noise of aircraft). Both of these measures focus on the louder end of the ambient noise spectrum without regard for how quiet conditions may be without human-caused noise sources. The national perspective in the NPS has firmly moved in a direction of using other measures what it considers acceptable for the nature of which parks were established.

The NPS monitoring efforts in south Florida have focussed on measuring the natural ambient sound levels, generally this is the lowest sound level in areas of the park that a visitor can expect to enjoy if all other sources of human-caused noise were absent. Sound measurements are expressed in terms of a logarithmic measure called the A-weighted decibel level (dBA). The A-weighted scale is chosen instead of other scales because this band of frequencies is in the range that the human ear can respond to (which is most sensitive at frequencies between 1,000 and 6,000 Hz).

Natural Ambient Sound Measurement

In the field, the natural ambient levels are estimated by recording the background or residual sound levels which are those sound levels present in the absence of intruding human-caused noise sources (Wyle, 1999). A commonly used metric by acousticians to estimate the background sound level is L90. If one were to take all of the one second LEQ (equivelent or average sound level for a time period) data collected by a sound meter for a given time period, then sort it from high to low, the L90 would be the value you would identify 90% down the list.

Observer-based Monitoring

Observer based noise monitoring provides the readings of the sound levels along with a record of the identification of the human-cause noise intrusion. The observer logs additional information such as the atmospheric conditions and the general setting in which the measurements were obtained. Observations can provide valuable later in interpreting the audio record for other purposes.

The trained observer will go into the field equipped with a sound level meter and a means of recording what the observer determines to be the source and duration of the noise event(s). On the most basic level this can be accomplished with a hand held sound level meter, and clip board with paper and a stop watch. The observer notes the source of the noise that he/she hears as the sound meter simultanously records the energy of the event. When the observer stops hearing that sound, or another noise source intrudes, the observer notes the duration of the first event, then shifts their attention to the second, and repeats the process. This effort can be enhanced with other more complex equipment.

LOWNOMS is a hardware/software system developed for the NPS for observer-based noise monitoring applications. It consists of a sensitive microphone intended to allow measurement of noise well below 20 dBA fitted with a unique microphone windscreen. Wind is measured with an ultrasonic device. A DAT recorder captures audio digital recordings of the sounds experienced. A laptop computer is included for logging the results of the operator's observations, and runs the software for the analysis of results. The unit is intended for field measurements of 1-3 hours at a time. The entire unit weighs approximately 65 pounds. It has been used extensively by both the NPS and contractors in western parks, Hawaii and here in south Florida.

A major limitation is the short time periods the data are collected using this method. The time of day, week, month or year, are all variables that may effect the overall sound levels. Using these small data samples it is difficult to determine the range of naturally occurring sound levels. The previous observer-based data were limited to daylight hours and precluded any understanding of the dirurnal variation in sound levels. In addition the quality of the observer's record depends on their skill and training. Even an attentive listener will find their attention wandering during the monitoring period. As a result a failure to note certain sounds or mis-labeling of sounds may occur. The issue of confusing audibilty based metrics (what the observer is hearing) with energy based metrics (what the sound level meter is recording) has been analyzed for the data collected in south Florida (Wyle, 1999). It is important to remember that these data are based on sound energy and not on audibility. The previously collected data for the park has been reanalyzed and the current metrics used for the "sound resource indicator" include this data and additional data collected for the park. Results from attended monitoring can be enhanced using a series of 24-hour unattended monitoring field measurements.

Unattended Monitoring

Acoustical data collected with unattended monitors that can be deployed for longer periods of time provides more data. Unattended monitoring gives a better perspective on diurnal, seasonal variations and the calculation of metrics such as L90. With this type of monitoring you can refine your field effort by identifying the frequency and or randomness of transient events. One can identify particular times of the day when attended monitoring is needed to distinguish types of transient events affecting the soundscape.

A series of 24-hour measurements can be recorded using a Larson-Davis 820 Sound Level Meter. The sound level meter is placed in the field enclosed in a water proof case. A sensitive microphone is positioned and taped outside the case with a spherical foam windscreen to reduce wind noise (up to 10 knots). When the memory fills up the unit needs to be downloaded to a laptop computer. In the field the units are time synched to the local time to facilitate comparisons between sites and with supporting data such as weather and digital audio sound recordings (DAT recorder).

Unattended monitoring of the sound levels can be used to address the following questions about the natural soundscape (Wyle, 1999):

- What is the level of dependence of the natural soundscape acoustical energy levels on the local ecosystem or acoustical zone (mangrove shoreline vs. forest)?
- What is the diurnal dependence of the soundscape?
- How do day-to-day, week-to-week, year-to-year variations in the soundscape compare to diurnal variations?

Sampling Strategies for Acoustic Data Collection

Depending on the availability of funding, staff, and equipment consider the following continuum of strategies from the least investment of time and money to the best case senario given enough resources.

Monitoring Approach and Instrumentation	Comments (see below for details)
Occasional attended monitoring with notebook and stopwatch	Listening + Identifying Sources
Occasional attended monitoring with Listening + Identifying Sources plus Long-term unattended monitoring	Listening + Identifying Sources Long-term unattended monitoring
Occasional attended monitoring with Listening + Identifying Sources and DAT recorder, plus Long-term unattended monitoring	Listening + Identifying Sources DAT recorder Long-term unattended monitoring
Occasional attended monitoring with LOWNOMS plus DAT recorder, plus Long-term unattended monitoring	LOWNOMS DAT Long-term unattended monitoring

Comments

Listening + Identifying Sources = Data collection requires attentive listening for intruding noise sources are heard and recording the sources and times they are heard.

Long-term unattended monitoring = Using a portable battery-powered noise monitor i.e. Larson-Davis 870 or 820.

DAT = Audio digital recording i.e. Sony D8, earphones, microphone, preamplifier, and calibrator.

LOWNOMS = Measurements that can be conducted with this or other similar systems that includes logging of noise sources, time and monitors wind speed.

Objectives for On-going Monitoring

- **Additional measurement to cover the entire park areas**

The goal would be to build on the current knowledge by building a data base of sound levels, the methods would include deploying a few unmanned monitors that are rotated to different sites on a week by week basis.

- **Seasonal variations in natural ambient soundscape**

The goal is to test the statistical independence of the A-weighted sound levels on acoustical zones of the park. If this independence remains throughout the year, then the A-weighted values can be used with certainty to represent large areas of the park.

- **Seasonal influences on the diurnal pattern**

The goal is to establish the diurnal pattern of sound levels, the methods would include at least five days of measurements at additional sites.

Seasonal variations in visitor impacts

The goal would be to establish noise levels in visitor use areas during various seasons in the park, especially in sensitive zones of the park where visitor use is highly variable. The methods would include manned and unmanned monitoring in these areas.

- **Observations to build a database of characteristic transient events _**

The goal of the observational data would be to assess the sound environment and the characteristics of the transient events occurring at the site. These observations will build a data base of both the natural and intrusive events that will be used for statistical discrimination of the events at other times and locations in the park. In addition the data will serve to assess the impacts on the natural soundscape from both current and proposed noise events.

Site Selection

Previous studies based site selections on representative acoustical zones, access to sites by walking or motor boat, and limitations on human intrusions. The entire park was not covered but all of the major acoustical zones (open water, forest on a key, key shoreline, and mangrove shoreline) were sampled. Equipment left out for several days was secured with a chain and lock.

(see site location map)

Table 1. List of Typical Sources of Sound and Noise in Biscayne National Park

Source Number	Source Description
1	Wind in the vegetation
2	Wind over the water
3	Water lapping on shore
4	Insects
5	Birds and other vertebrates
6	People (talking, walking, camping)
7	Road traffic or vehicles (autos, buses, trucks)
8	Vessels (motor boats)
9	Recreation vehicles (boats, jetskies)
10	Aircraft (propeller, helicopter, military jet, commercial aircraft)
11	Storms (thunderstorms, huricanes)
12	Power devices (air conditioners, generators)
13	Audio devices (communication radios, boom boxes)

Table 2. Acoustic Zones and Possible Contributing Sound and Noise Sources

Open Water Pelican Bank Featherbed Bank	2,5,8,9,10,11
Mangrove Shoreline Key (protected shoreline) Long Arsenicker Key Old Rhodes Key	1,2,3,4,5,8,9,10,11
Shoreline Key (open shoreline) Adam's Key	1,2,3,4,5,6,8,9,10,11,12,13
Forest (open forest) Elliot Key-picnic area	1,2,3,4,5,6,8,9,10,11,12,13
Dense Forest (dense forest) Elliot Key-nature trail	1,2,3,4,5,6,10,11
Development Zone Convoy Point	1,2,3,4,5,6,7,8,9,10,11,12,13

Table 3a. Sound Measurement Site List and Temporal Variability of Expected Sound/Noise Sources

Site No. and Location	Sound Environment	Sound Sources Expected	Associated Temporal Variability	Accessibility (travel time from HQ)	Resource Sensitivity
B1 Convoy Point	Open Shoreline	Water/Water/ Insects	diurnal	O minutes	Development Zone Low
		Birds and other vertebrates	diurnal		
		People walking/talking	Open hours		
		Audio devices	Open hours		
		Cars, trucks	Open hours		
		Power devices	Diurnal		
		Motor boats	Open hours		
		(excluding military) Aircraft	diurnal		
		Military Aircraft	8pm to 6pm		

B2 Elliott Key-picnic	Open Forest	Wind/Water/ Insects	diurnal	30 minutes	Development Zone Low
		Birds and other vertebrates	diurnal		
		Recreation vehicles	Day		
		People walking/talking/camping	Diurnal		
		Vessels	Diurnal		
		Military Aircraft	8am to 6pm		
		Aircraft (except military)	Diurnal		
		Power devices	Diurnal		
		Audio devices	Day		

For more monitoring details and guidance see the **Sound and Noise Monitoring Guidelines for the NPS** in Reference Manual #47, Soundscape Preservation and Noise Management (in draft, 1999).

Appendix F: List of Related Resources Action Plans

- *National Park Service Cultural Resources Strategic Plan.* U.S. Department of the Interior, National Park Service (1997).

- *National Park Service Natural Resources Strategic Plan.* U.S. Department of the Interior, National Park Service (1997).

- *Resource Management Plan for Biscayne National Park.* U.S. Department of the Interior, National Park Service (1995)

- *Florida Keys National Marine Sanctuary. Final Management Plan/Environmental Impact Statement.* Volumes I, II, III. 1996. US Dept. of Commerce. National Oceanic and Atmospheric Administration (NOAA).

Appendix G: laws, regulations, and orders

The guidelines for cultural resource management in the national park system are derived from a hierarchy of laws, proclamation, orders, regulations, and policies. A summary list of regulations and directives that pertain to Biscayne National Park follows. A more comprehensive listing can be found in the NPS

Laws and Executive Orders

National Park Service Act of 1916 - "...[T]he fundamental purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." (*Organic Act (16 U.S.C. § 1))*

Endangered Species Act, Amended, 1983 - Requires federal agencies to ensure that any action authorized, funded, or carried out does not jeopardize the continued existence of any endangered or threatened species, or result in the destruction or adverse modifications of critical habitat.

Historic Sites Act of 1935: declared "a national policy to preserve for public use historic sites, buildings, and objects..."; authorized the programs known as the Historic American Buildings Survey, the Historic American Engineering Record, and the National Historic Landmarks Survey; authorized the NPS to "restore, reconstruct, rehabilitate, preserve, and maintain historic or prehistoric sites, buildings, objects, and properties of national historical or archaeological significance and ... establish and maintain museums in connection therewith"; authorized cooperative agreements with other parties to preserve and manage historic properties.

National Historic Preservation Act of 1966: declared a national policy of historic preservation, including the encouragement of preservation on the state and private levels; authorized the secretary of the interior to expand and maintain a National Register of Historic Places including properties of state and local as well as national significance; authorized matching federal grants to the states and the National Trust for Historic Preservation for surveys and planning and for acquiring and developing National Register properties; established the Advisory Council on Historic Preservation; required federal agencies to consider the effects of their undertakings on National Register properties (and properties eligible for listing) and provide the Advisory Council opportunities to comment (Section 106). Amended in 1976 to expand Section 106 to incorporate E.O. 11593 requirements (see below), to give national historic landmarks extra protection in federal project planning, and to permit federal agencies to lease historic properties and apply the proceeds to any National Register properties under their administration. Amended in 1992 to, among other things, redefined federal undertakings, address "anticipatory demolition," and emphasize the interests and involvement of Native Americans and Native Hawaiians.

National Environmental Policy Act of 1969: declared a federal policy to "preserve important historic, cultural, and natural aspects of our national heritage"; required federal agencies to "utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences... in planning and in decision making

which may have an impact on man's environment."

National Outdoor Recreation Act of 1963 - Declared a national policy to support recreation activities; the National Park Service provides national leadership and coordination of this public-private partnership.

Regulations

National Park Service Regulations on Resource Protection, Public Use, and Recreation (36 CFR Part 2). These regulations establish National Park Service policies prohibiting unreasonable noise in camping areas between the hours of 10:00 p.m. and 6:00 a.m. (§ 2.10(a)(4)) and operation of motorized equipment or machinery that exceeds a noise level of 60 decibels measured on A-weighted scale at a distance of 50 feet (§ 2.12(a)(1)).

National Park Service Regulations on Boating and Water Use Activities (36 CFR Part 3). These regulations establish National Park Service policies prohibiting operation of a vessel to exceed a noise level of 82 decibels measured at a distance of 82 feet (§ 3.7).

National Park Service Reference Manual on Soundscape Preservation and Noise Management (RM 47). This reference manual includes Director Order 47 on soundscape preservation, as well as, applicable policies and procedures, technical guidance on planning, monitoring, education, noise prevention and mitigation, and other information designed to help field managers and staff meet their responsibilities.

Presidential Memorandum for the Heads of Executive Departments and Agencies (April 22, 1996). This Presidential Memorandum mandates additional planning for addressing the impacts of transportation on national parks. The memorandum said that intrusion of low altitude aircraft can "mar the natural beauty of the parks and create significant noise problems..." and can interfere with wildlife, cultural resources, and visitor enjoyment.

36 CFR 2.5 (NPS Act of 1916) states conditions under which park superintendents may permit collection of plants, fish, wildlife, rocks, and minerals, including museum catalog requirements.

NPS Orders and Guidance

Director's Order 2: Park Planning
This director's order revises and replaces the policies and guidence included in Chapter 2 of the National Park Service management Policies, 1998 as it related to park planning. The planning and decision-making framework compiles and integrates all servicewide directives related to park planning.

Director's Order Staff Directive 96-1, "Linking Cultural and Natural Resource and Socio-economic Data to Park Planning and Management," provides guidance on the kinds and level of detail of information needed about park resources for planning and decision-making and identifies sources of that information.