

BIG BEND NATIONAL PARK TEXAS

WILDLAND FIRE MANAGEMENT PLAN

June 2005

**Prepared by
BIG BEND NATIONAL PARK**

**With assistance from
INTERMOUNTAIN REGIONAL OFFICE
Denver, Colorado and Santa Fe, New Mexico**



UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

WILDLAND FIRE MANAGEMENT PLAN
BIG BEND NATIONAL PARK

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Date: October 1, 2005

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I INTRODUCTION

A. PURPOSE AND NEED FOR DEVELOPMENT OF THIS FIRE MANAGEMENT PLAN

The purpose is to implement an improved and updated Wildland Fire Management Plan (FMP) for Big Bend National Park. The fire management plan provides a framework for making fire-related decisions and serves as an operations manual. Updating the 1994 plan allows changes in fire policy, fire behavior knowledge, prescribed burn results, and revisions in NPS policies to be implemented in practice. By incorporating new information about ecology, fire effects and firefighting techniques, the FMP will improve the protection of people, property, and resources within the park.

Current resource managers acknowledge three major challenges in managing vegetation at the park: greatly increased fuels in forest and some woodlands increasing risk from high-severity fire; invasion of fire-adapted nonnative plant species which threaten to displace native species primarily along the riparian corridor and drainages; and, altered fire patterns from suppression and grazing of livestock. Prioritizing and meeting these challenges requires a significant shift in management direction for training, funding, and support of project monitoring and evaluation, and maintaining the commitment to implementing new policies over the long-term.

Assessments of the park in the 1940s and 1960s suggested that fire be reintroduced to counter changes in vegetation resulting from suppression and grazing. Staff shortages, limited resources and cautious administrators led to continued suppression of most natural ignitions under earlier FMPs (1973, 1978, 1980, and 1994). A prescribed fire program began in 1980 to protect developments and has burned 2,080 acres in 25 years. Two prescribed fires to develop defensible space and reduce fuels that did occur in backcountry escaped, leading to new prescriptions under this revised FMP to ensure greater safety. Over the same 25-year period, there were 242 lightning-caused fires, which burned 19,127 acres, suggesting a need to allow more natural fires to reduce fuels and to burn where they occurred historically.

B. COLLABORATION

This plan was developed with the assistance of the Fire Management Program staff, the Science and Resources Management staff, and the Management Team at Big Bend National Park. The University of Arizona, School of Renewable Natural Resources, assisted through their involvement in completing the Environmental Assessment (EA). The Intermountain Region Fire and Aviation staff made contributions to the plan. The plan began with the foundation on the most recent Fire Management Plan (1994) and then added the most recent information available to complete the process.

As of 2004, Big Bend National Park is in the Southwest Texas Fire Planning Unit. This unit includes four federal administrative units managed by the National Park Service and includes approximately 12.5 million acres of federal, state, NGO, and private lands. The park staff continues to work collaboratively with other federal, state, NGO, and local land management agencies to implement the fire management and interagency planning actions required under the new Fire Program Analysis program.

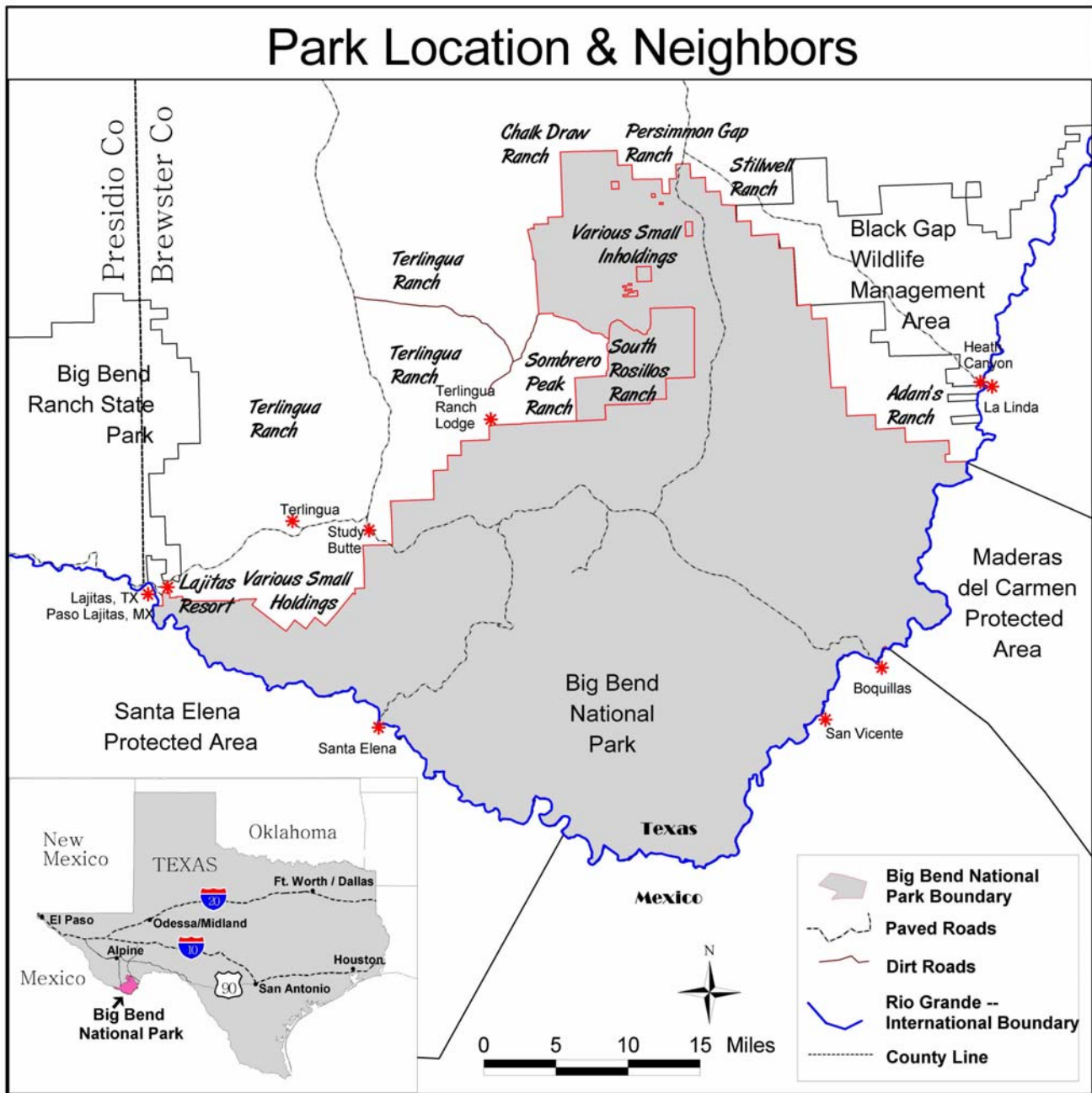


Figure I-1 Park Location and Neighbors

C. NATIONAL FIRE MANAGEMENT GOALS

The Wildland Fire Management Plan will implement the policies and support the achievement of goals identified in the *Review and Update of the Federal Wildland Fire Management Policy, January 2001*, *Managing Impacts of Wildfires on Communities and Environment and Protecting People and Sustaining Resources in Fire Adapted Ecosystems – A Cohesive Strategy (1999)*, and *A Collaborative Approach for Reducing Wildland Fire Risks to Communities and Environment: 10-year Comprehensive Strategy Implementation Plan (2002)*.

Additionally, the plan meets the requirements set forth in *Director's Order-18 (DO-18, NPS 2003)* the NPS guidance for Wildland Fire Management, which states that, "every NPS unit with burnable vegetation must have an approved Fire Management Plan." DO-18 defines what an approved FMP must include, stressing that "firefighter and public safety is the first priority" and promoting "an interagency approach to managing fires on an ecosystem basis across agency boundaries."

D. RELATIONSHIP TO ENVIRONMENTAL COMPLIANCE

General management of the Big Bend National Park, including general guidelines for wildland fire management, has been assessed through the formal analysis process required by the National Environmental Policy Act of 1969 (NEPA), 42 U.S.C. 4321-4347. An Environmental Impact Statement (EIS) was written and approved for the General Management Plan (GMP) and the Record of Decision was signed by the Intermountain Regional Director in September 2004.

This Wildland Fire Management Plan, which is a document that is tiered from the GMP and the Resource Management Plan (1995), articulates specific wildland fire management practices, procedures, and policies. Adoptions of programs or plans, such as those that guide or prescribe uses upon which future agency actions may be based, require environmental analyses before a decision is made. That analysis is documented in an Environmental Assessment of the Fire Management Plan for Big Bend National Park. A Finding of No Significant Impact was signed by the Intermountain Regional Director on Sept 29, 2005.

Requirements of the National Historic Preservation Act (NHPA) have been met through a review of the Cultural Resource Component of the Wildland Fire Management Plan by park and regional archeologists and an additional review requested by the Texas State Historic Preservation Office.

Requirements of the Endangered Species Act, Section 7, were met through Formal Consultation with the Fish and Wildlife Service initiated in June of 2005 on three species, a bird, a bat and a cactus. The Fish and Wildlife Service responded with a Biological Opinion which concluded that, as proposed in Big Bend's Fire Management Plan Environmental Assessment and Biological Assessment, the projects are not likely to jeopardize the continued existence of the black-capped vireo, Chisos Mountain hedgehog cactus, or the Mexican long-nosed bat. They also concluded that as no critical habitat had been identified for any of the species, none would be affected.

E. AUTHORITIES

The authority for fire management is found in the National Park Service Organic Act (Act of August 25, 1916), which states that, the Agency's 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."

This authority was further clarified in the National Parks and Recreation Act of 1978:

"Congress declares that...these areas, though distinct in character, are united...into one National Park System.... The authorization of activities shall be construed and the protection, management, and administration of these areas shall be conducted in light of the high public value and integrity of the National Park System and shall not be exercised in derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress."

Additional statutory authorities are:

- The General Authorities Act of 1970
- Establishment-Authorization Act (June 20, 1935, 49 Stat. 393, appended) Establishing Big Bend National Park
- The Clean Air Act, Clean Water Act
- The Endangered Species Act
- The Antiquities Act.

II RELATIONSHIP OF LAND MANAGEMENT PLANNING TO FIRE POLICY

A. NPS MANAGEMENT POLICIES CONCERNING WILDLAND FIRE MANAGEMENT

NPS Management Policies (2001) Section 4.5 defines how the NPS will meet its park management responsibilities under the 1916 NPS Organic Act. The NPS recognizes that the presence as well as the absence of fire influences park landscapes, ecosystems, and operations. Management considerations are summarized below:

- Parks with vegetation capable of burning will prepare fire management plans and address funding and staffing required by fire programs.
- Fire management programs will meet resource management objectives while ensuring protection of life and property.
- Fire plan development will include the NEPA compliance process and necessary collaborations with outside parties.
- Fires in vegetation are to be classified as wildland or prescribed fires and managed according to considerations of resource values, safety, and cost.
- Prescribed fires are ignited to achieve resource management goals and closely monitored to determine whether they successfully meet objectives.
- Parks lacking approved plans must suppress all wildland fires using methods that are the most cost effective while causing the least impact.
- Suppression in wilderness will be consistent with the "minimum requirement" concept.

NPS Management Policies (NPS 2001) also states: "Biological or physical processes altered in the past by human activities may need to be actively managed to restore them to a natural condition or to maintain the closest approximation of the natural conditions in situations in which a truly natural system is no longer attainable...The extent and degree of management actions taken to protect or restore park ecosystems or their components will be based on clearly articulated, well-supported management objectives and the best scientific information available. "

B. ENABLING LEGISLATION OF BIG BEND NATIONAL PARK

1. Big Bend National Park was created by the Establishment-Authorization Act (June 20, 1935, 49 Stat. 393, appended). This Act provides that "lands...as necessary for recreational park purposes...are hereby established, dedicated, and set apart as a public park for the benefit and enjoyment of the people." This act also stipulates that the provisions of the National Park Service Organic Act apply.

Further, the Establishment-Authorization Act required that lands for Big Bend National Park be secured only by public and private donations. Subsequent acts were passed on August 30, 1949 (63 Stat. 679), August 8, 1953 (67 Stat. 497), and December 28, 1980 (94 Stat. 3539). These acts authorized the Secretary of the Interior to acquire lands in certain sections of Brewster County, Texas, and to procure the remaining non-Federal land and interests within the boundaries of Big Bend National Park.

2. Big Bend National Park is named for its location on the deep 100-mile-radius bend in the Rio Grande in southwest Texas (Figure I-1). In authorizing a park in 1944, Congress recognized the area's rich biology, geology, cultural history, and outstanding recreational opportunities. International recognition of the park's resources came with a UNESCO Man and the Biosphere Reserve designation in 1976. Prehistoric sites dating back 10,000 years testify to the significance of the region to humans. European efforts to colonize this area began in the 1500s heralding tumultuous times as Europeans, Mexicans, and American Indians fought for control until the late 1880s. The park now hosts an average of 300,000 visitors annually from across the United States and from around the world. Visitors seek respite, scenic beauty, and recreational opportunities in the 801,163 acres of mountains, desert, and river, two-thirds of which is proposed wilderness.

C. PARK-WIDE DESIRED CONDITIONS AS THEY PERTAIN TO FIRE MANAGEMENT OBJECTIVES

The General Management Plan (2004), the Statement for Management (1992), and the Strategic Plan (1997), determine how Big Bend manages its resources. All plans recognize objectives directly related to comprehensive fire management. These documents emphasize the need for research to support management of natural resources, management across ecosystems, (which requires the cooperation of private, state and Mexican landowners), and the preservation and interpretation of the park's many scenic geological, biological, cultural and historical features. The provisions in this Wildland Fire Management Plan and the mitigation measures listed in the EA/FONSI and the US Fish and Wildlife Service Biological Opinion are consistent with these directions.

The recent revision of the General Management Plan (Big Bend National Park, 2004) reaffirms Wildland Fire Management practices. The GMP (2004) describes park goals to attain park-wide desired conditions:

- Restore native plant and animal populations in the park that have been extirpated by past human caused actions, where feasible.
- Whenever possible, natural processes will be relied upon to maintain native plant and animal species, and to influence natural fluctuations in populations of these species.
- Protect a full range of genetic types (genotypes) of native plant and animal populations in the park by perpetuating natural evolutionary processes and minimizing human interference with evolving genetic diversity.

The current Statement for Management recognizes the need to maintain the dynamic Chihuahuan Desert ecosystem while minimizing impacts on that system; the need to identify, research, and interpret the ecological, historical, and cultural resources of the area; and, the necessity of cooperating with neighbors in the public and private sector. The Strategic Plan identifies that one of the purposes of Big Bend National Park is to preserve and protect all natural and significant cultural resources and values.

D. RESOURCE MANAGEMENT PLAN OBJECTIVES AS THEY PERTAIN TO FIRE MANAGEMENT

The current Resources Management Plan (1995) addresses the Natural Fire Regime issue, acknowledges heavy accumulation of hazard fuels and focuses on the implementation of a Wildland Fire Management Plan. The Resource Management Plan (RMP) calls for a significant commitment to training fire personnel, hazard fuel reduction, fire monitoring and suppression, and research into fire effects from prescribed fires in the Chihuahuan Desert vegetation.

E. MEETING GMP AND RMP OBJECTIVES

This Fire Management Plan, a moderate revision of the 1994 plan, is based upon information gained from management actions taken on wildfires and prescribed fires, and from studies of fire history and vegetation community ecology. New technologies in fire science, as well as changes in National Park Service fire policy, are also incorporated into this revision. This plan will implement a broad range of fire prevention and suppression strategies to protect developments, visitor/employee safety, and cultural and natural resources at risk from Wildland fire impacts. Wildland Fire Use will be carefully implemented as a natural process of several park ecosystems. Prescribed fire will be implemented to

reduce hazardous fuels, and to conduct research, and restore ecosystems that benefit from the dynamic role of Wildland fire. Non-fire fuel treatments and emergency rehabilitation/restoration will be implemented to reduce hazard to values at risk from wildland fires.

III WILDLAND FIRE MANAGEMENT STRATEGIES

A. GENERAL MANAGEMENT CONSIDERATIONS

Big Bend National Park is within the Lincoln Zone (LNZ) of the Southwest Area. Five federal land management agencies and one state agency (FS, BLM, BIA, FWS, NPS and State of New Mexico Forestry Division) are participants with the Zone. The Lincoln Zone Interagency Fire Operations Plan is updated annually to establish operational guidelines, roles, and responsibilities for fire management programs in the LNZ and to comply with the most current federal wildland fire management policies and directives.

This Fire Management Plan is a strategic document that complements the annual LNZ Operations Plan. Consistent with the National Fire Plan, the core principles of the 10-year Comprehensive Strategy, as well as the annual Lincoln Interagency Fire Operations Plan and the General Management Plan for Big Bend National Park, this Fire Management Plan delineates fire management units and identifies appropriate fire management strategies within the units for the protection of life and property as well as preservation of natural and cultural resources. Wildland Fire Management priorities are set, accountability for actions is defined and collaboration with partners is considered.

B. WILDLAND FIRE MANAGEMENT GOALS

Big Bend National Park's fire management program goals and objectives are aligned with the Park's General Management Plan goals and the guidelines of the National Fire Plan. The fire management program goals and objectives are listed in descending order of their priority:

Table III-1 Goals and Objectives of the Big Bend Fire Management Plan

GOAL 1: Protecting people and property is the highest priority of every fire management activity.

Objectives to achieve goal:

- Prevent injuries to the public, staff, and fire personnel.
- Reduce fuels that could threaten life and property using prescribed fire and mechanical or other non-fire fuel reduction methods.
- Prevent human-caused wildland fires through public education.
- Maintain safe egress from all areas of the park in case of fire.

GOAL 2: Apply wildland fire use, prescribed fire, non-fire fuel reduction measures, and fire suppression to accomplish natural resource management objectives.

Objectives to achieve goal:

- Determine the natural range of variability of the fire-return intervals.
- Determine desired conditions and condition classes for vegetation categories.
- Use fire as a restoration tool and/or as a maintenance tool.
- Monitor results of fire program activities and adjust management based on new knowledge.
- Where possible, ultimately allow fire to resume its natural role in park ecosystems.

GOAL 3: Apply wildland fire use, prescribed fire, non-fire fuel reduction measures, and suppression to accomplish cultural resource management objectives.

Objectives to achieve goal:

- Use prescribed fire to reduce fuels around sensitive sites.
- Restore and/or maintain cultural landscapes.

Take advantage of surveying opportunities during and after fire operations.

GOAL 4: Minimize unacceptable environmental impacts of fire program activities on natural and cultural resources.

Objectives to achieve goal:

- Properly plan each activity and conduct pre-action surveys.
- Carefully determine prescriptions.
- Suppress fires that fail to meet management objectives.
- Use minimum impact suppression tactics (MIST).
- Confer with resource advisors.

GOAL 5: Cooperate fully with adjacent land management agencies and private landowners in the management of fire near park boundaries.

Objectives to achieve goal:

- Maintain communication and educate the park neighbors about the fire program.
- Formalize relationships and conduct joint fire management activities with neighbors.

GOAL 6: Coordinate fire activities with all park divisions, concessionaires, and the public.

Objectives to achieve goal:

- Maintain multiple lines of communication with all parties, in particular using the daily briefing sheet, website, and interpretive programs.
- Bring together structural and wildland fire planning operations.
- Incorporate appropriate fire management tasks into all park divisions.

By aligning with the Park's General Management Plan goals and the guidelines of the National Fire Plan, the six Fire Management Goals contribute to accomplishing national, regional and park-wide strategic plans. These plans include federal wildland fire policy, the core principles and goals of the Comprehensive Strategy, the Cohesive Strategy, the 10 year Implementation Strategy and land management planning for adjacent areas.

C. WILDLAND FIRE MANAGEMENT OPTIONS

1. Wildland Fire Suppression: Wildland fire suppression is an appropriate management response to wildland fire that results in curtailment of fire spread and eliminates all identified threats from the particular fire. All wildland suppression activities provide for firefighter and public safety as the highest consideration, but minimize loss of resource values, economic expenditures, and/or the use of critical firefighting resources.

Under this Fire Management Plan, approximately 23% of the Park is zoned for suppression to protect structures, historic resources, private lands, rare plant species, and lands where the flammability of the vegetation has been altered by invasive grasses. The decision to suppress a Wildland fire may be applied anywhere in the park, based on the current analysis by resource managers. Additionally, all human caused ignitions will be suppressed regardless of their location.

2. Prescribed Fire: A prescribed fire is any fire ignited by qualified park managers to meet specific objectives within a specific geographic location. A written, approved prescribed fire plan must exist and environmental compliance requirements must be met prior to ignition. Appropriate objectives include burns conducted for research or scientific purposes, reduction of hazard fuels, restoration of a natural process to fire-dependent plant communities, maintenance of a historic scene/landscape or removal of exotic plant species. Prescribed fire may be used throughout the park.

3. Wildland Fire Use: Wildland fire use is the management of naturally ignited wildland fires to accomplish specific pre-stated resource management objectives in pre-defined geographic areas outlined in this Fire Management Plan. Operational management is described in the Wildland Fire Implementation Plan (WFIP), Appendix K. The WFIP is an expandable document that is prepared for each fire use incident. This option relates to the land and resource direction to allow natural processes and maintain a dynamic ecosystem. Wildland Fire Use is a management option for approximately 77% of the park lands.

4. Non-fire Treatments: Non-fire treatments for fuels include mechanical, chemical, biological and manual methods. These treatments may be used individually or as a phase of multiple treatment methods to achieve resource benefits and managements goals such as hazard fuels reduction, ecosystem restoration, and maintaining ecosystem health.

Mechanical fuel reduction is identified for implementation in this Fire Management Plan. Mechanical fuel management uses hand and/or power tools

to cut or remove live or dead vegetation to decrease either the volume or flammability of the fuels. Fuels treatments are planned activities that are conducted before a fire occurs in order to reduce fire risk. The various fuel treatments proposed in Big Bend National Park are hazard fuel reduction immediately adjacent to park owned structures, including concessionaire-operated facilities, adjacent to campsites, roads, cultural resource sites and along prescribed burn unit perimeters.

The Park may also incorporate hazard fuel reduction and fire preparedness requirements into various permits and agreements that involve structures inside of Big Bend National Park. Examples include boundary fence, utility rights-of-ways and communication sites, as well as the research and education facilities operated by universities. Private or public in-holdings located within the Park that are not legally subject to permits or agreements cannot be required to adhere to hazard fuel reduction. To encourage such owners/operators to voluntarily implement fire prevention measures, the Park will implement a fire prevention and education campaign and work with property owners and residents to reduce fuel hazards.

The Park has no plans to employ biological means to reduce fuels. This includes the use of cattle or other introduced grazing animals.

The use of herbicide for fuel reduction treatments will be considered in separate planning and compliance documents such as the Vegetation Management Plan.

D. DESCRIPTION OF WILDLAND FIRE MANAGEMENT STRATEGIES BY FIRE MANAGEMENT UNIT

A Fire Management Unit (FMU) identify an area of the Park that is assigned different fire management objectives and strategies based on management constraints, fire regime, and the human, natural, and cultural resource values to be protected. By designating Fire Management Units, decision-making processes regarding the use of fire and fire suppression are simplified for the Incident Commander and/or Fire Program Manager.

There are three Fire Management Units within Big Bend National Park. Appropriate fire management objectives and strategies within each Unit are based on condition class, vegetation type, known fire history, behavior and effects, resource concerns, accessibility, and proximity to developed areas, private property and homes. One key variable in the delineation of fire management units is the application of Wildland Fire Use in FMU #2. Virtual boundaries exist between FMU #1 and #2 due to the locations of values to be

protected. An assessment of the values at risk will determine how the ignition will be managed. FMU #3 has a delineated boundary.

Common to the all units, every unplanned human-caused ignition (different from planned prescribed fire) is suppressed. Firefighter and public safety, protection of property, and responsible stewardship of all resources are primary concerns in the consideration of tactical or operational fire management efforts in all Fire Management Units.

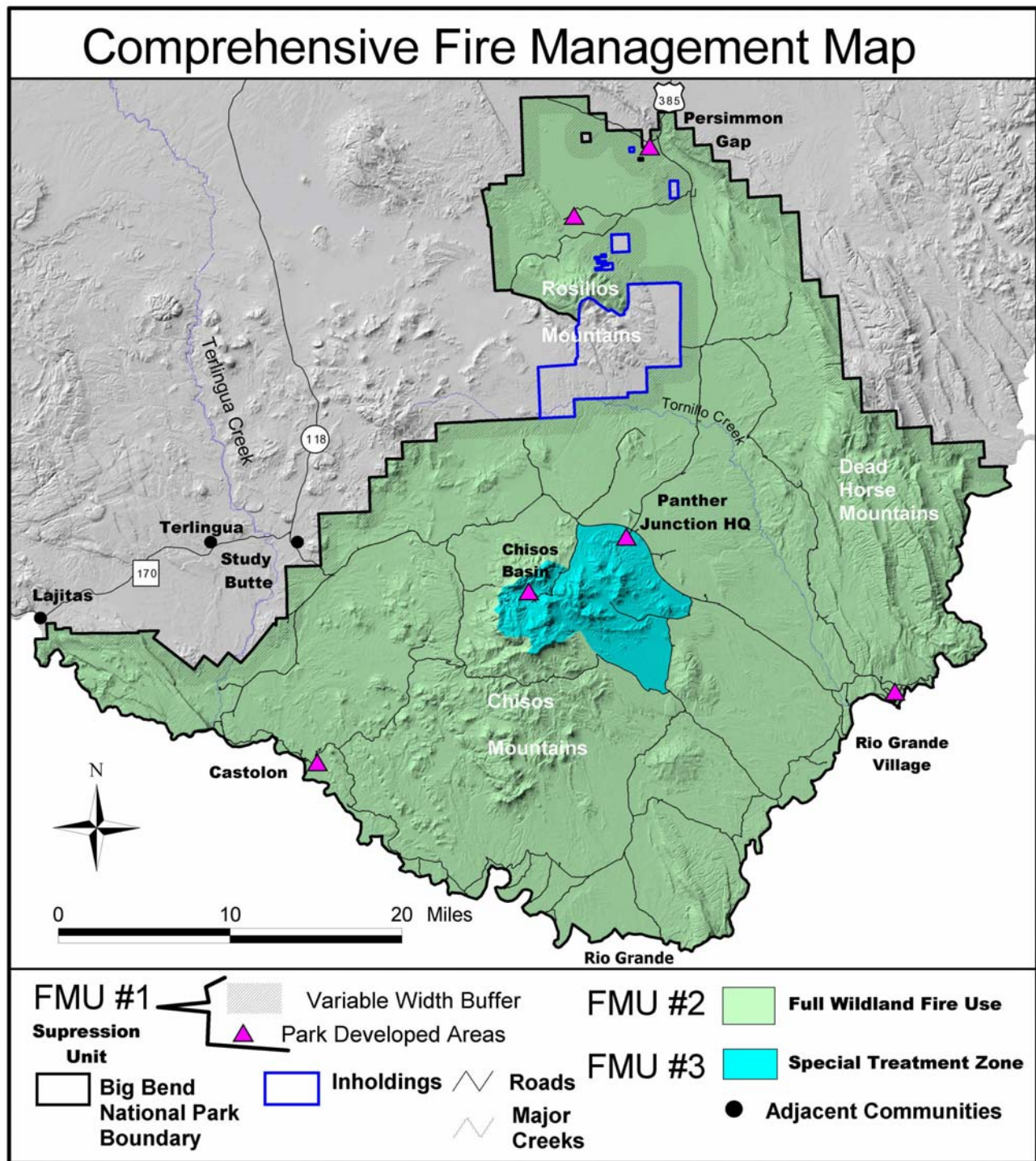


Figure III-1 Comprehensive Fire Management Map.

1. **Fire Management Unit #1:** FMU 1, designated as the Suppression Unit, contains approximately 187,300 acres (23%) and includes developments, utility corridors, fire-susceptible cultural resource sites, legally protected species and habitat, private in-holdings and a variable-width suppression buffer along park boundaries.

The strategy for managing fire in FMU #1 is to suppress all fires using methods necessary to confine, contain, or control, as deemed appropriate by the designated Incident Commander. All fires in FMU #1 will be extinguished using an appropriate management response in a manner that causes the least damage to resources, persons, and property. Due consideration will be given to cost-effectiveness of the suppression action(s) chosen.

a. Physical and Biotic Characteristics of FMU #1:

Developed Areas, Utilities, and Private Lands: Approximately 1341 acres are developed in the park and considered Wildland-Urban Interface areas, including five visitor service locations; Persimmon Gap, Panther Junction (Park Headquarters), Chisos Basin, Castolon, and Rio Grande Village. Isolated structures such as Maverick Entrance Station, Harte Ranch, K-Bar Ranch and Barker Lodge, as well as all private land in-holdings are included. Approximately 24,470 acres are privately owned and within the park boundary. Ninety-five miles of power line roads access 86 miles of power lines that cross through the park. Telephone lines are underground located along the shoulders of park roads.

Cultural Resources: There are more than 1650 sites in a cultural site database at the park, and new sites are added as they are found. Currently, less than 3% of the park area has been surveyed. Based on a NPS system-wide Archeological Site Estimation Project in 2002, the NPS has estimated that Big Bend National Park contains more than 26,000 archeological sites dating from 8000 B.C. to "the Historic Period." Any activity that alters the original condition of the site or the cultural materials within it potentially reduces the scientific values that may qualify the site for the National Register. Protecting archeological context is the most important consideration.

Legally Protected Species: Protecting federally listed species requires careful precautions to safeguard individuals, populations, and their habitats over the long-term. The park supports many animal species, but staff considered only those that for reasons of population size, federal protection, or limited habitat, needed special consideration in this FMP. A list of these species can be found in the Biological Assessment. The appropriate protection measures are found in the Biological Opinion.

Boundary Buffer: Agreements are being negotiated with neighboring agencies and large landowners to shrink the standard

fire suppression buffer (1 mile) to a variable limit that allows fire to burn to natural or manageable boundaries such as the river, roads, bare areas, and cliffs both in the park and beyond. The expected benefits include more cost-effective use of fire management resources, safer fire management practices, and less damage to soils and vegetation from suppression activities. The Rio Grande forms the park boundary for 118 miles. This international boundary fire suppression buffer contains 75,520 acres. The administrative boundary on the Northeast and Northwest is approximately 145 miles and the buffer area includes approximately 85,953 acres.

Vegetation Types

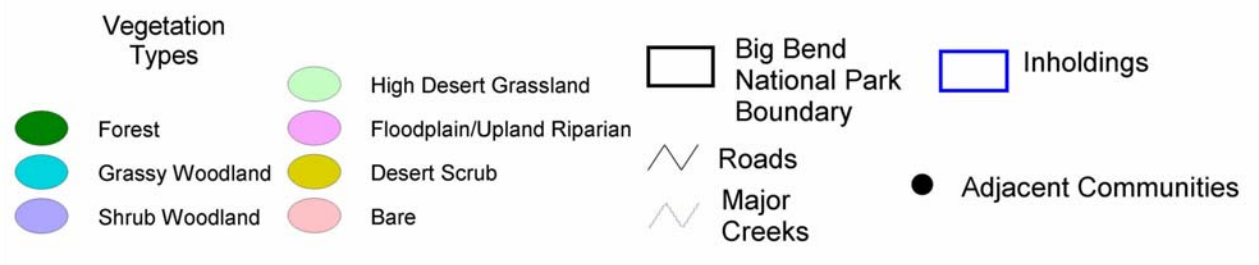
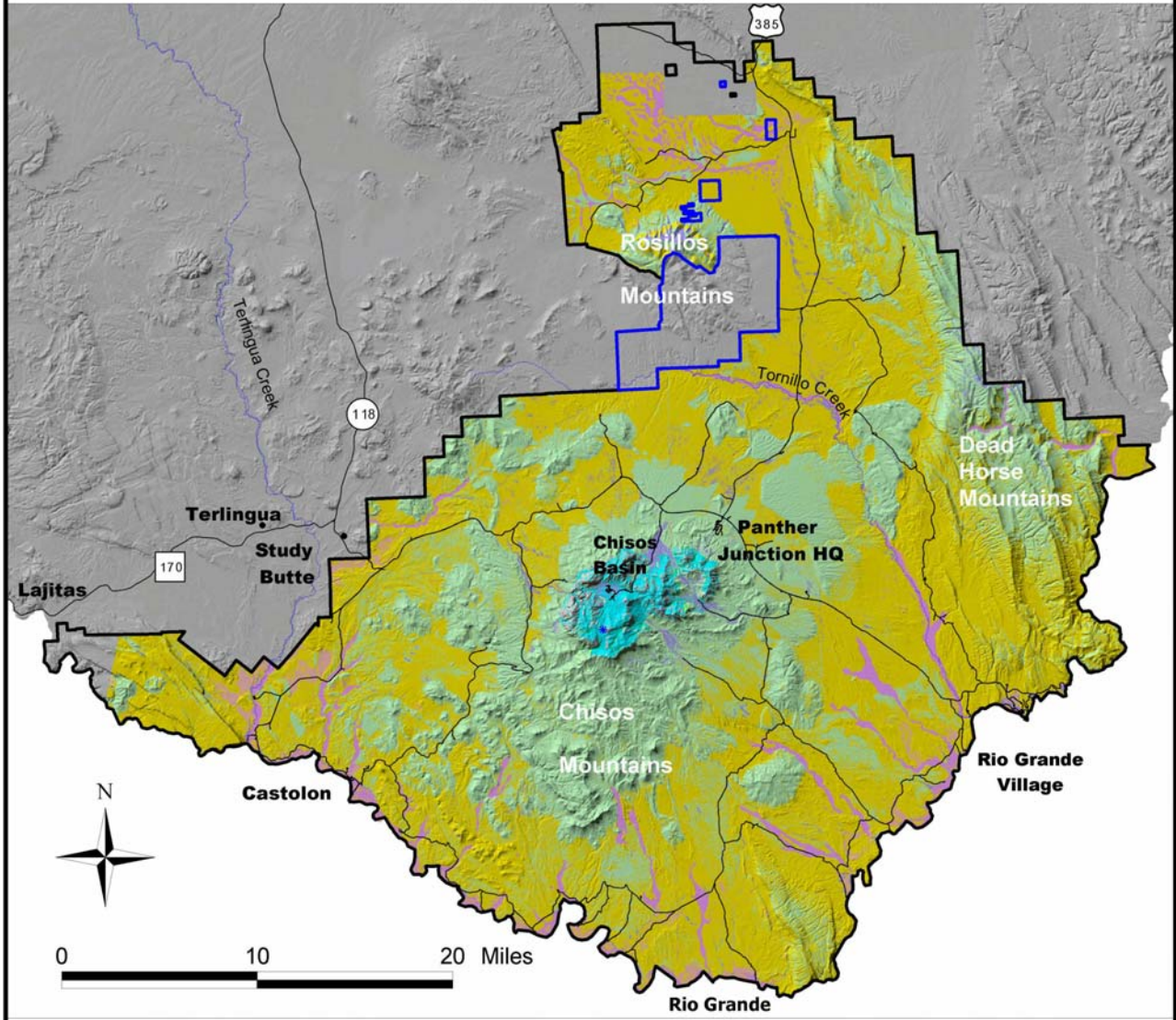


Figure III-2 Vegetation Map

Vegetation Categories of FMU #1:

1. Floodplain/Upland Riparian (occurs in FMU #1 and #2):

Two cover-mapping categories, Mixed Riparian and Desert Willow from Plumb (1993), form this vegetation category. The Rio Grande, with a high water table and dependable water year round, supports considerable stands of vegetation. Although this category comprises just 3% of the park, this vegetation type forms a vital lifeline for animals and humans. Historic photos taken in 1901 show a mostly denuded riparian corridor (Schmidley 2002). The erosive force of frequent floods kept the river clear of reed beds and promoted scattered gallery forests of cottonwood and willow with open floodplains of mesquite, acacia, screw bean, desert willow, and *Baccharis* spp. Several upstream dams in Mexico and New Mexico now capture floodwaters. Fire would have been uncommon prior to humans with lightning ignitions extinguished by high humidities and fuel moistures during summer. Understory was probably sparse. Now, fire can be supported with increased ground and ladder fuels from exotic species, which recover faster after fire than the natives. Fire is more frequent year-round from abundant human visitation and carelessness with campfires.

Upland Springs: Springs, seeps and tinajas provide precious waters for wildlife and are found throughout the mountains and low elevation desert. They were claimed by ranchers and exotics gradually became established. Now park staff is systematically removing salt cedar from springs and seeps allowing natives to reestablish.

Common species: Floodplain - cottonwood, honey mesquite, screw bean, willow, desert willow, *Acacia* spp., shrubby groundsel, burro bush, common reed; exotics include salt cedar, giant reed, Bermuda grass, and buffelgrass.

Upland springs – overstory varies with site; oaks and junipers at higher elevations; some willow and cottonwood and small tree species at lower sites; alkali sacaton, deer muhly and riparian forbs are common in the understory. Salt cedar occurs at some sites and is dominant in places.

Floodplain - Upland Riparian has the following characteristics:

- Present structure: The floodplain is vegetated with dense stands of nonnative salt cedar and giant reed thickets along the shore. The historical intermittent gallery forests of native

cottonwoods and honey mesquite *bosques* believed to exist prior to Europeans are found in small patches (Schmidley 2002). Native understory includes *Baccharis* spp. and scattered native grasses. Introduced Bermuda grass and buffelgrass are dense where sun and moisture are present. Upland Spring's dominant vegetation varies by spring; most salt cedar has been removed.

- Fire Regime Condition Class: Floodplain –III; Upland springs to I- II (designation depends on whether they have they recovered from grazing impacts and if exotic salt cedar has been removed); Lower reaches of drainages –II; Headwaters of drainages –I
- Condition on recent burns: Wetlands: Rio Grande Village burn (February, 2003) of high severity has shown high recruitment of cottonwood seedlings in ash beds. Other areas required additional plantings. Response to fire in the giant reed suggests regular burning at 5-yr intervals to reduce risk. Floodplains: Jewell fire (April, 2002, 88 acres) between Mariscal and Santa Elena- arson set fire burned ~ 300 year old mesquite *bosque*, which is re-sprouting. Bermuda grass has responded vigorously after fire. San Vicente fire (2000, 27 acre) removed native overstory and salt cedar; both types of vegetation are re-sprouting. Upland springs: The history of exotics at springs suggests that fire may remove native overstory giving competitive advantage to more fire tolerant exotics. Other controls are necessary following fire at springs.
- Fuel model: Floodplain –8 (Slow-burning ground fires with low flame lengths. The fire-supporting layer is composed of compact leaf litter, needles, leaves and twigs).

Upland Springs – 3 (Fire is carried through tall grasses where one-third or more are considered cured or dead. Highest intensity of the grass fires, especially under wind.)

- Fire Cause and Frequency: Natural fire uncommon with high relative humidities and fuel moistures, wet soils. Human caused fires are common along the river.
- Insect/disease: None seen at present.
- Problem invasives: Large sections of the riparian corridor have salt cedar, with giant reed prevalent where the waters slow; buffelgrass established in upland arroyos.

Management considerations: The major goals are to have scouring floods restored (beyond the control of park administration), and to contain and remove exotics, gradually restoring native vegetation.

Floodplain: Staff is planning to contain exotics; initiate pilot restoration of natives; use fire when it occurs as part of an integrated restoration program for native species which may include sowing seed in ash beds and applying herbicide to freshly cut stumps of salt cedar; and, to protect mature cottonwoods from fire by shielding the trunks. Seedlings may need protection from rabbits and rodents as well as Mexican livestock, which ignore the international boundary. Salt cedar will be removed from arroyos as resources are available. Monitoring and photos will capture changes in exotic cover along the floodplain and arroyos associated with restoration projects and control of exotics.

Wetlands: Staff proposes burning giant reed on a 5-year rotation to reduce high-intensity fire threatening endangered species habitat in selected localities.

Upland springs: Exotics will continue to be removed over time; mature native overstory species will be protected from fire wherever possible.

3. *Scrub Desert (occurs in FMU #1, #2 & #3):* This vegetation category was compiled from five cover-mapping categories from Plumb (1993): Creosote-Lechuguilla-Grass, Creosote-Lechuguilla-Prickly Pear, Creosote-Tarbush, Creosote-Yucca-Grass, and Lechuguilla-Candelilla-Hetchia. Scrub Desert is dominated by shrubs (creosote, mariola and ocotillo) and succulents (prickly pear, lechuguilla, and Texas hetchia or false agave). Grasses are subdominant and provide insufficient fuels to carry fire. Scrub Desert occurs over half the park between the low-lying floodplains at 1,700 ft to mid-elevation desert grasslands at 3,000 ft. Average annual precipitation of 8-12 inches falls mostly in summer with high rates of evaporation.

Common Species: Creosote, tarbush, lechuguilla, mariola, prickly pear, candelilla, hetchia, tobosagrass, sacaton, chino grama.

Scrub Desert has the following characteristics:

- Present structure: Sparse desert shrubs, succulents and grasses. Grasses are unlikely to carry fire in this category but high winds may carry fire through shrubs. Scrub Desert

is unlikely to be a fire-maintained association because of the paucity of grasses. In the past, there were more grasses, including dense flats of tobosagrass on Tornillo Flat, and other playas, and fire may have been more common.

- Fire Regime Condition Class: Where native shrub and succulents dominant –I (across most of the park); Arroyos invaded by exotics –II; Exotic grasses dominant –III. There is the risk of changing fire-regime because these exotics respond more vigorously after fire than natives.
- Condition on recent burns: A prescribed burn in Comanche Draw, 6 miles south of Persimmon Gap in February 2003 (537 acres) showed a slight increase in grass cover from 1% in control plots to 2.5% in treated plots (McKernan 2003). Only one of the past two years of above average monsoon precipitation was included in results and grass recovery may be higher over the next year.
- Fire Cause and Frequency: Lightning ignited fires are infrequent and usually do not carry far because of fine discontinuous grassy fuels (10-13% cover). Fire may carry through the shrub layer under high winds.
- Fuel model: 1 (Fire spread is governed by fine, porous, and continuous herbaceous fuels that are almost cured. Typical of grasslands and grass-shrub assemblages and has high rates of spread.)
- Insect/disease: No problem areas at present.
- Problem invasives: Buffelgrass is colonizing arroyos that lead into the Rio Grande (Guertin 2004) converting shrub-dominated areas to highly flammable grasslands.

Management considerations: Major goals are to let natural fires burn within prescriptions and to use research burns to understand how fire may aid restoration of grasslands, particularly tobosagrass and sacaton. Desert Scrub is the buffer zone to keeping buffelgrass out of high desert "sotol" grasslands. Developing methods to aid grass establishment may help curb buffelgrass infestation. Growth of grasses following fire in 2003 at Comanche Draw shows that sites that increase moisture retention may increase recruitment of grasses in above average summer rainfall years (McKernan 2003). Options for buffelgrass areas are to suppress, or to burn and follow up with additional controls.

4. High Desert Grasslands (occurs in FMU #1, #2 & #3):

This vegetation category has the most species per unit area in the park. High Desert Grasslands cover about 40 percent of the park ranging from 3,000 to 5,000 ft in elevation with scattered plants

occurring in the heights of the Chisos. Annual rainfall is 10-16 inches with most occurring in summer. Lightning caused fires are common in this category and dependent on understory fuels. High Desert Grasslands can support large fires (>1,000 acres) with sotol and yucca acting as receivers of lightning strikes and spreading fire as they roll downhill. Biological surveyor Vernon Bailey reported in 1901 that "Luxuriant grass covers almost the whole of the mountains ...," suggesting more frequent fire at low and moderate intensities that maintained open canopies and grassy understory (Schmidley 2002). The grasslands contain some shrubs and low-growing trees, with cacti largely confined to drainages that supported little grass and to areas of rocky and shallow soils (Humphrey 1958). After 60 years without livestock, grasses in this category appear to have recovered from grazing.

Common Species: Lechuguilla, prickly pear, bear-grass, sotol, toothleaf goldeneye, yucca, skeletonleaf golden-eye, ceniza, *Acacia* spp., *Dalea* spp., grama grasses (Chino, blue, black, hairy and sideoats), tanglehead, Mexican lovegrass, California cottontop, green sprangletop and threeawn, tobosa grass and alkali sacaton. Shrubs are found on drainages in deeper soils, with grasses, sotols and succulents found more on ridges and shallow soils. Exceptions are tobosagrass and sacaton which are found on deep clay soils in undrained basins.

High Desert Grasslands have the following characteristics:

- Present structure: Grasses are widespread on well-drained igneous soils and now support landscape-scale fire (>1000 acres). Without fire, shrubs will increase onto shallow soils on slopes and ridge tops outside what may be their normal range in canyon bottoms.
- Fire Regime Condition class: I -with some shrub encroachment.
- Condition on recent burns: The Gap fire (1992, 2412 acres) at mile marker 4 on highway 118- showed considerable decrease in lechuguilla, recovery of grasses, and increased diversity; Sotol Vista fire (1991, 680 acres) caused by lightning shows recovery of grasses and shrubs, with catclaw and mesquite re-sprouting slowly; Estufa fire (1994; 3,774 acres) near Panther Junction needs to be compared with equivalent unburned area to document fire effects.
- Fire Cause and Frequency: Caused by lightning; fire frequency estimated to be 7-10 years (McPherson 1995)

- Fuel model: 2 (Fire spread is from fine cured herbaceous fuels in addition to litter and downed stemwood. Open shrublands, scrub oak and some juniper-pine assemblages fit this model.)
- Insect/disease: None present.
- Problem invasives: Buffelgrass and Lehmann lovegrass have established in some high desert grassland habitats. King Ranch bluestem has become common on roadsides.

Management considerations: Major goals are to maintain and stimulate plant diversity, allow natural burns within prescriptions, shrink shrub encroachment along the grass-woodland ecotone, and develop natural firebreaks wherever possible.

Grasses have recovered sufficiently from grazing to carry landscape-scale fires. Grazing and then drought (7 years following park establishment) allowed shrubs to out compete grasses. Several burns may be necessary to incrementally remove shrubs from shallower soils on slopes and ridge tops allowing reestablishment of grasses. Ideally incremental fires will cause shrubs to retreat to deeper soils along drainage lines and at the grasslands woodlands ecotone. Monitoring will detect changes in species diversity and fire effects, and photos can help document shrub encroachment.

The invasive exotic, Lehman lovegrass, poses a threat by displacing native species, increasing fuel loading, intensifying fire behavior and increasing fire frequency. Experiments with and without herbicide following fire are proposed for the 1314 burn site, where Lehman lovegrass could contribute a large amount of fine fuel. Photos and other appropriate vegetation metrics (cover, density or biomass) as determined by the Fire Effects Monitoring Plan will be used to document fire effects in natural burns and for selected prescribed burns.

5. *Shrub Woodland (occurs in FMU #1, #2 & #3):* This vegetation category contains three cover-mapping categories from Plumb (1993). These are Mixed Scrub, Oak Scrub, and Mixed Oak-Shrub Woodlands. This category includes many different shrub-dominated communities scattered in the foothills and mountains of the Chisos Mountains and Dead Horse Mountains. Elevation is from 4,500 ft at Green Gulch to 5,500 ft near the Chisos Basin. Annual precipitation averages 12 to 16 inches.

Common species: Low growth gray and Emory oak, catclaw acacia, catclaw mimosa, bee bush, slimleaf vaquelinia, evergreen sumac, shorthorn jefea, and low-growth redberry (also known as Pinchot juniper) and alligator junipers.

Shrub Woodland has the following characteristics:

- Present structure: The occurrence of shrubby thickets may be associated with human disturbance or higher precipitation at increasing elevation. Catclaw acacia and bee brush thickets are densest where stock camps, stock pens and homesteads were located. Evidence of grazing suggests that fires were also suppressed allowing juniper, piñon and oak to increase and canopies to close. These woody fuels and thickets are generally not near ridge tops or areas conducive to lightning and have suppressed understory fine fuels, limiting the spread of fire. Fires are most likely to occur when high winds drive a grass fire into these areas.
- Fire Regime Condition Class: II
- Condition on recent burns: Blue Creek (1989, 334 acres) human caused, burned the scattered overstory of piñon and juniper at high intensity causing high mortality; scrub oak and shrub re-growth is very thick and grasses have responded strongly.
- Fuel model: 6 (Fire carries through the shrub layer at moderate wind speeds but drops to the ground at lower speeds and at breaks in the canopy.)
- Fire Cause and Frequency: Lightning prior to monsoon. Probably frequent surface fires that kept canopies open, maintained grassy understory and limited stand density, estimated 10-30 years (Kaib et al. 1996).
- Insect/disease: Some areas of oaks stripped in 1999 and 2000 by variable oakleaf caterpillar. Mild winters accompanied by drought stress possibly caused death of the trees.
- Problem invasives: Buffelgrass has established at the Chisos Basin, demonstrating adaptation to lower temperatures than has been recorded. Global warming trends may lead to its establishment in burned areas during mild winters.

Management considerations: Major goals are to keep natural ignitions within low and moderate intensities; protect the habitat of federally listed species'; restore areas heavily impacted by grazing in Green Gulch and Oak Canyon; and, create a plan for managing fire moving upslope from high desert grasslands. Fires would thin

juniper and piñon saplings and reduce shrub cover. Results from monitoring would shape future management decisions. Monitoring will capture fire effects, condition of habitat for federally listed species, and cover of bee bush and prickly pear where heavy livestock use occurred.

b. Fire Management Objectives: The following Fire Management Plan objectives apply to FMU #1:

Protecting people and property objectives:

- Prevent injuries to the public, staff, and fire personnel.
- Reduce fuels that pose a threat to life and property using prescribed fire and mechanical fuel reduction methods.
- Prevent human-caused wildland fires through public education.
- Maintain safe egress (by hazard fuel reduction, fuel breaks, etc.) from all areas of the park in case of fire.

Natural and Cultural resources objectives:

- Properly plan each activity with resource managers
- Conduct pre-action surveys.
- Carefully apply burning prescriptions.
- Suppress fires that fail to meet management objectives.
- Use minimum impact suppression tactics [MIST].
- Confer with resource advisors.
- Take advantage of surveying opportunities during and after fire operations
- Restore and/or maintain cultural landscapes.
- Use prescribed fire to reduce fuels around sensitive sites.
- Fire Management activities are conducted in accordance with applicable terms and conditions established in the Biological Opinion issued by the U.S. Fish and Wildlife Service.

Park boundary objectives:

- Maintain communication with park neighbors and educate communities about the fire program.
- Formalize relationships and conduct joint fire management activities with neighbors.

c. Management Considerations: Specific management considerations are outlined for each vegetation type in the vegetation type description. Additionally, there are no in-holdings

at risk from wildfire in Fire Management Unit #1 because of the sparse vegetation surrounding them. Structural fire protection is managed by NPS personnel within the park. Wildland fire engines will provide wildland exposure protection and assist with water delivery as requested.

Structural fire protection to in-holdings may pose problems due to long suppression response times by Brewster County and insufficient water supply and water pressure. Risk of wildland fires resulting from structural fires is probably not significant, as fuels to carry fire are generally sparse plus structures are surrounded by cleared areas, roads, and other barriers to fire.

d. Historic Role of Fire: Mild winter and early spring temperatures, comfortable relative humidity levels, abundant sunshine, and lack of rain produce ideal conditions for maximum outdoor activity, resulting in Big Bend's main visitor use season, March 1 through Spring Break-Easter. A late winter/early spring "green-up" may occur providing that winter precipitation has been adequate. However, an abundance of cured vegetation may likely be available as a result of the previous year's growth. All of these variables--available vegetation (fuels), visitation patterns, and seasonal weather conditions--account for the first peak of fires evident in the data.

An assessment of fire reports from 1980 indicate the majority of human-caused ignitions were less than 0.1 acre in size and started near the main roads in or adjacent to the developed areas, primarily Chisos Basin and Panther Junction. Natural ignitions clustered in the higher elevation areas in the Chisos - Sierra Quemada - Deadhorse Mountain ranges, and varied in size from 0.1 to 0.5 acre in size. A few natural starts, which developed into wildfires larger than 1000 acres (April/May, July), occurred in the High Desert Grasslands. In general, smaller fires occurring along roadways were wildland exposures resulting from car fires in areas of light or previously burned fuels, so spread was minimal. Natural ignitions burned in mid elevation areas where fire spread was contained by sparse fuels or natural barriers. Large fires were driven by frontal or thunderstorm winds and easily controlled only after winds subsided and/or rain ensued. Since 1980, Big Bend National Park averages 15.3 unplanned ignitions/year with 1.3 fires exceeding 100 acres/year.

Table III-2 Fire from 1946 - 2004 by Size Class, Month, and Ignition Source.

> 1000 acres				2	2		5						Human Lightning 9 MIPF
100 - 999 acres			4	2	1		5	1					Human 7 Lightning 14 MIPF 2
10 - 99 acres		2	1	2	1	1	4	1	1	2			Human 10 Lightning 18 MIPF 10
1 - 9.9 acres	1	4	9	8	4	3	1	2	6	2	2	1	Human 43 Lightning 55 MIPF 11
0 - 0.9 acres	9	11	23	26	13	11	8	2	2	6	6	5	Human 122 Lightning 229 MIPF 4
Monthly Totals >	Jan (14)	Feb (26)	Mar (48)	Apr (87)	May (127)	Jun (82)	Jul (79)	Aug (29)	Sep (24)	Oct (21)	Nov (8)	Dec (6)	
Unknown acres		1		1	5	3	1	1					Human 12 Lightning 5 MIPF

Fire Ecology and Fire History: The effects of fire were investigated on higher elevation vegetation in the Chisos, and lower desert scrub and grasses. Researchers have sought to identify pre-European fire frequency by identifying fire scars in tree rings. Moir (1982), in reconstructing fire history of the Chisos Mountains, found 10 tree-scarring fires in Boot Canyon and the Southeast Rim with fires between 9 and 60 or more years apart conservatively estimating a fire-return interval of 70 years. In a study of 63 woodland sites throughout the southwest from 1700, Swetnam and Baisan noted fire return intervals of 1-89 years with a mean of 25 years (1996). In the Guadalupe Mountains Ashlstand (1981) noted mixed conifer forest averaged fire every five years from 1554-1842. In an effort to clarify fire trends for this region, Helen Mills at Yale University is currently undertaking a comparative study by of the Davis, Chisos and the Sierra Del Carmen Mountains to reconstruct historic vegetative structure and fire frequency. When resource managers know the historic range of variability for fire, they can identify restoration processes for small changes, or accept a type conversion.

The last sizable fire in the Chisos was in 1903. Lack of fire is attributed to grazing (from 1880s to 1940s), drought (in 1890s and 1950s especially) and suppression (since grazing) which promoted shrub growth over grasses. That grasses once carried fire into the Chisos is suggested by government biological surveyor Vernon Bailey, who wrote in 1901, "Luxuriant grass covers almost the whole of the mountains..." and "Oaks, pines and junipers are the dominant trees..." suggesting frequent low-intensity fire, which kept woodlands open (Schmidley 2002:350). The current non-flammability despite high fuel loads may reflect the topography of sheer cliffs, talus slopes and rocky terrain. The change of carrier fuels in forest areas from grasses to leaf litter, ladder, dead and downed fuels and small trees, will mean hotter fires, and may hamper efforts to maintain burns within prescriptions (Fule, et al., 2004). The abundant high desert grasses noted by the surveyor Bailey have taken 60 years without livestock to recover and could carry landscape scale fire into higher elevation woodlands and forests. McPherson (1995) estimates fire return intervals in desert grasslands at 7- 10 years, but this may need tempering to local fuel conditions.

The lower elevation desert contains mosaics of shrubs and grasses, and mixes of both depending on landform. Conditions prior to grazing can only be inferred. Mule train owners cut Chino grama,

and perhaps tobosagrass to feed their animals (Gomez, 1991). Langford and Gipson described grasses as abundant "knee deep to a horse...only the tallest of the desert plants stood out above it" (1952). Other inferences by Tyler (1975), and Fulcher (1959) referred to periodic abundant grass and although these ranchers lacked scientist's trained eyes, they knew grass turned cows into money. Overgrazing led to sheet and rill erosion, channel cutting and conversion to more drought tolerant shrubs rather than perennial grasses. Muldavin, et al. (2001), examined vegetative changes in the park from 1955 to 1996 on 5 soil types and estimated it takes from 25-40 years for overgrazed sites to recover comparable vegetation, with recovery highly dependent on moisture.

That fire is the primary shaper of these ecosystems is debated. Hastings and Turner (1965) point to the paucity of fire in desert grasslands and the influence of other agents including human activity, climate, soils, drainage patterns, and rodent effect on seed sources – in shaping vegetation. Cornelius (1988) noted that recovery of desert shrubs after fire often exceeds that of dominant perennial grasses. A prescribed burn in 2003 in the northeast of the park however showed a slight increase in grasses within a year. Above average precipitation in the growing season and availability of seed sources may lead to greater establishment of grasses (Drewa and Havstad 2001; McKernan 2003; Muldavin, et al., 2001). Fire is expected to be infrequent in these low biomass/ density assemblages where landform shapes moisture conditions (Wondzell, et al. 1996). The shrub to grass ratio is dynamic, shaped primarily by moisture (Muldavin, et al., 2001) and then by fire and other agents.

The fire history data and precipitation records from 1948 to 2003, suggest that there is strong relationship between the amount of area burned in Big Bend National Park and the adjacent surrounding area and the amount of precipitation received in preceding years. Grass is the primary carrier of fire at the park and the amount of grass increases with increasing precipitation. In drought years grass production is low and any grass grown in a preceding wet period will decrease thus limiting fire spread. However, during wetter periods more grass is produced and the ability of fire to spread increases (Figure III-3). The drought of the 1950s and the most recent drought of the late 1990s resulted in limited burned area. In contrast, the wet period of the last half of the 1980s resulted in several years where more than 1000 acres were burned. Notably, when the 5-year average precipitation exceeds 20.9 inches (Chisos

Basin) then the chance of burning more than 1000 acres is greater than 50% (Table III-3). While precipitation is a major driver for vegetation dynamics in desert environments, it is also a major driver for fire dynamics. The interrelationship of these two forces of nature is not well understood and will require further study to more fully understand fire's role in structure and function of desert vegetation.

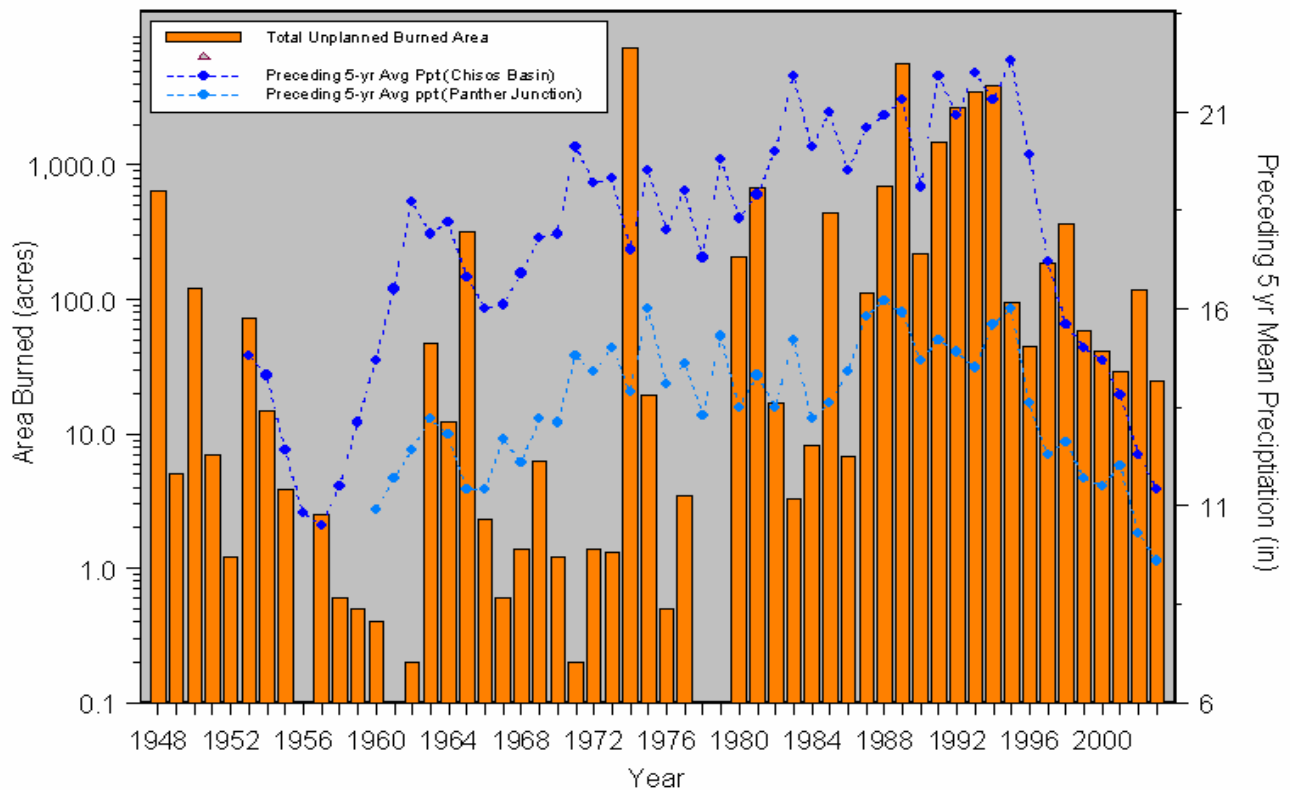


Figure III-3 Plot of the burned area for each fire year from 1948 to 2003 and the preceding 5-yr average precipitation. Each bar represents the total area burned in acres from all unplanned starts (Human and lightning) for that year. The two dotted lines are the preceding 5-yr average precipitation for the Chisos Basin (5400 ft elev.) and Panther Junction (3750 ft elev.) for that year. For example the precipitation value plotted for the fire year 1987, is the precipitation values averaged over the preceding 5 year period, 1982 to 1986.

Table III-3 Probability of occurrence for total burned area for Big Bend National Park and the adjacent surrounding area given the 5 year average precipitation preceding any given fire year.

Fire Year Burned Area (acres)	Preceding 5-yr Average Precipitation (inches)		
	<14.0 (n=6 yrs)	14.0 to <20.9 (n=33 yrs)	≥20.9 (n=9 yrs)
<10	57%	47%	11%
10 to <100	29%	28%	11%
100 to <1000	14%	22%	22%
≥1000	0%	3%	56%

Fire History -- 1946 to 2003

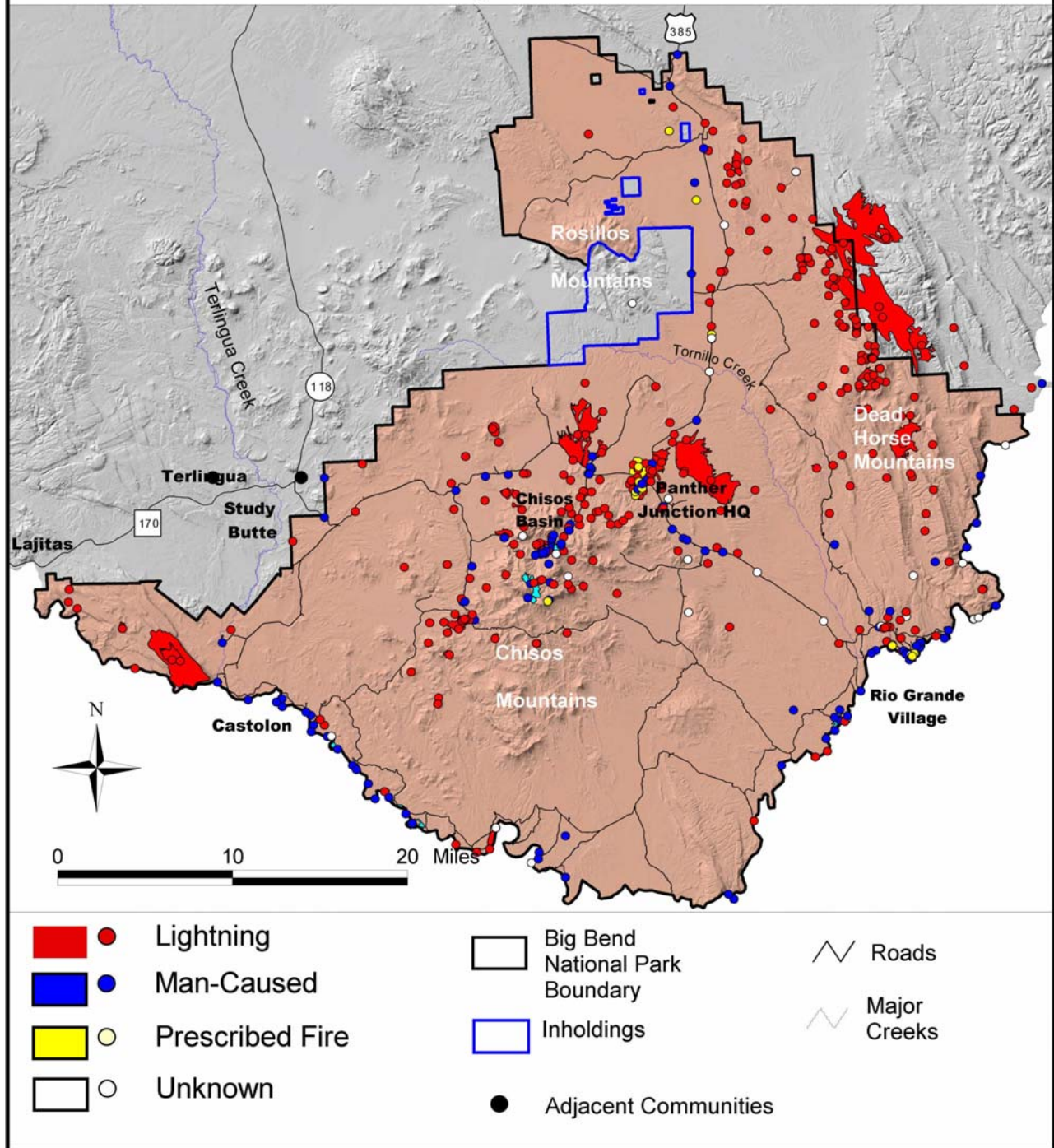


Figure III-4: Map of Fire History

e. Wildland Fire Management Situation

1) Historical Weather Analysis: The modern climate of the park is arid, with average annual precipitation ranging from less than 8 inches at the lower elevations to more than 19 inches in the higher montane elevations. Precipitation generally increases with elevation. Most rainfall occurs in the form of thundershowers during the months of July, August, and early September. During this period, locally heavy thunderstorms and flash flooding can occur. Summer storms bring higher humidities and a cooling effect which reduces temperatures.

Winter is the dry season, with precipitation averaging less than one-half inch per month. Snow occasionally falls during January and February, but rarely in great amounts. It infrequently lingers on shaded northern aspects. Occasionally, blustery "northers" may sweep the area November through April. These fronts may be accompanied by chilling winds and blowing dust. Strong winds are generally associated with weather fronts and thermal activity. The weather is more settled after mid-April. During fall, the flow of moisture from the Gulf of Mexico is interrupted by invasions of cooler, drier polar air masses. Average monthly temperature and precipitation measurements taken from Panther Junction weather station are shown in Table III-4. This table represents the general climate at the park's median elevation. Temperatures in the higher mountain areas vary about 5 to 10 degrees below those shown in the table, while temperatures along the Rio Grande run from 5 to 10 degrees higher. Wide variations of weather can occur across the park. Spatial and temporal variations of climate are a factor in determining the park's fire season, as discussed later.

Table III-4 Average Temperature and Precipitation Panther Junction Weather Station, Elevation: 3,750 feet

Month	Average Temperature (°F)		Average Precipitation (in)
	Maximum	Minimum	
January	61	35	0.46
February	66	38	0.34
March	74	45	0.31
April	81	52	0.7
May	88	59	1.5
June	94	66	1.93
July	93	68	2.09
August	91	66	2.35
September	86	62	2.12
October	79	53	2.27
November	69	42	0.7
December	62	36	0.57
Total:			15.34

As the spring season advances, average temperature increases substantially through late May and June, the hottest months of the year. The average June maximum is 94.2°F at Panther Junction, with a distinct gradation of higher temperatures as elevation decreases. Daily Rio Grande Village temperatures generally run over 100°F. As local weather systems become more active, isolated storm cells develop with increased lightning activity, but precipitation usually remains light. The combination of available vegetation (fuels), local topography, and seasonal weather combine to form another fire peak from lightning ignitions.

2) Fire Season: March 15 through July 15. The fire season is somewhat variable with a later start if weather remains cool into the spring. Vegetation can support fire by May 1 but in some years it may support fire as early as March if cool season grasses cure during an early warm spell following a wet fall. Lightning ignitions generally occur between late April and mid-July. Lightning is often accompanied by heavy rain but on some occasions multiple dry strikes occur. High winds contribute to fire spread but generally blazes are limited to 0.10 acre or less and require minimal suppression actions, if any. In most situations the absence of wind precludes extensive fire spread. By late July, fire activity drops off significantly.

3) Fuel Characteristics in Relation to Fire

Behavior: Annual drying of fuels over winter contributes to receptive fuels in spring from human-caused ignitions. The previous summer and fall grass crop is standing and available along with cured annuals.

4) Fire regime alteration:

Some compositional change has occurred in the Floodplain/Upland Riparian and Scrub Desert vegetation types due to the proliferation of non-native annual grasses. The presence of these non-native species may have altered the natural fuel regime by occupying the inter-shrub spaces thus creating a more continuous fuel bed resulting in larger fires. These invasive species and the altered fire regime are most common in the Rio Grande floodplain, chronically disturbed areas such as those found along roadsides and grazing lands frequented wild burros and trespass livestock.

5) Control problems and dominant topographic features:

Control problems could range from low to extreme depending on the site and burning conditions. Spring winds are normally very strong, which greatly increases fire spread. The largest fires to date have been associated with thunderstorms. The mountain terrain influences local wind patterns, accessibility, vegetation density and fire spread. Natural barriers are present and will be used when available.

Along the river corridor, the dense riparian vegetation contributes to spotting. Big Bend's remoteness and the required lengthy response time for resources outside the park is a major factor in fire control. Wildland/Urban Interface needs to be considered in three of the five developed areas.

6) Other Elements of Fire Environment:

The Wildfire Protection Agreement with Mexico allows firefighting resources from either country crossing the international boundary to suppress threatening Wildland fires. The paucity of available firefighting resources in the area must be considered along with risks and values during elevated fire danger situations. The park is designated a Class I air shed. The unknown location of many cultural sites requires minimal ground disturbance.

2. Fire Management Unit #2: FMU 2, designated as the Wildland Fire Use Unit, contains approximately 574,900 acres of the remote backcountry including 533,900 acres of proposed wilderness.

The preferred strategy for managing fire in FMU #2 is to allow the natural ecological processes to occur so as to perpetuate and maintain un-manipulated ecosystems to the maximum extent possible. Naturally ignited fires may burn under predetermined prescriptions and conditions as listed in Table IV-10. The cause of each fire must be determined in order to make proper management decisions. The prescription for Wildland Fire Use precludes permitting this type of fire for resource benefit to enter FMU #1. Any Wildland Fire Use spread that threatens values to be protected in FMU #1 will be checked with an appropriate management response.

a. Physical and Biotic Characteristics of FMU #2: FMU #2 is that portion of park lands that does not include developments, utility corridors, fire-susceptible cultural resource sites, legally protected species and habitat, private in-holdings and a variable-width suppression buffer along park boundaries. A virtual boundary exists between FMU #1 and FMU #2 due to the locations of values to be protected (i.e. remote historic properties). An assessment of the values at risk will determine if the ignition will be managed within FMU #2.

Vegetation Categories of FMU #2:

1. *1. Floodplain/Upland Riparian (occurs in FMU #1 and #2):* This vegetation description and the management considerations is the same as described in FMU #1.
2. *Scrub Desert (occurs in FMU #1; #2 and #3):* This vegetation description and the management considerations is the same as described in FMU #1.
3. *High Desert Grasslands (occurs in FMU #1; #2 and #3):* This vegetation description and the management considerations is the same as described in FMU #1.
4. *Shrub Woodland (occurs in FMU #1; #2 and #3):* This vegetation description and the management considerations is the same as described in FMU #1.
5. *Grassy Woodland (occurs in FMU #1; #2 and #3):* This vegetation description and the management considerations is the same as described in FMU #3.

b. Fire Management Objectives specific to FMU #2:

The following are objectives to protect people and property:

- Prevent injuries to the public, staff, and fire personnel.
- Reduce fuels that poses a threat to life and property using prescribed fire and mechanical fuel reduction methods.
- Prevent human-caused wildland fires through public education.
- Maintain safe egress (by hazard fuel reduction, fuel breaks, etc.) from all areas of the park in case of fire.
- Incorporate appropriate fire management tasks (such as providing additional firefighters) into all park divisions.

Natural resource management objectives:

- Properly plan each activity with resource managers
- Determine the natural range of variability of fire-return intervals.
- Determine desired conditions and condition classes for vegetation categories.
- Use fire as a restoration tool or as a maintenance tool.
- Monitor results of fire program activities and adjust management based on new knowledge.
- Where possible, ultimately allow fire to resume its natural role in park ecosystems.
- Carefully apply burning prescriptions.
- Suppress fires that fail to meet management objectives.
- Use minimum impact suppression tactics (MIST).
- Confer with resource advisors.
- Take advantage of surveying opportunities during and after fire operations
- Restore and/or maintain cultural landscapes.
- Use prescribed fire to reduce fuels around sensitive sites.
- Fire Management activities are conducted in accordance with applicable terms and conditions established in the Biological Opinion issued by the U.S. Fish and Wildlife Service.

c. Management Considerations: Specific management considerations are outlined for each vegetation type in the vegetation type description. A qualified Fire Use Manager will be required for each Wildland fire use incident. Such Wildland fire use must be confined within the FMU #2. All Wildland Fire Use fires are

to be monitored daily, or more frequently, using the Wildland Fire Implementation Plan (WFIP). The Fire Use Manager must collect and maintain current information on size, location, behavior, smoke dispersal, safety conditions, and fire effects as described in RM-18, Chapter 11.

d. Historic role of fire: This information for FMU #2 is the same as found in FMU #1

e. Wildland Fire Management Situation:

1. Historical Weather Analysis: This information for FMU #2 is the same as found in FMU #1

2. Fire Season: This information for FMU #2 is the same as found in FMU #1

3. Fuel Characteristics in relation to fire behavior: The fuels lack continuity. Calibration to fire behavior outputs is required to accurately predict observed fire behavior. This is particularly true using Fuel Models 1, 2, 6 and 8.

4. Fire Regime alteration: This information for FMU #2 is the same as found in FMU #1

5. Control Problems and dominant topographic features: Control problems could range from low to extreme depending on site specifics and burning conditions. Spring winds are normally very strong, which greatly increases any fire spread. The largest fires to date have been associated with thunderstorms. The mountain terrain influences local wind patterns, accessibility, vegetation density and fire spread rates up steep slopes. Natural barriers are present and will be used when available.

Along the river corridor, the dense riparian vegetation contributes to spotting. Big Bend's remoteness and the required lengthy response time for outside of park resources is a factor in fire control.

6. Other elements: This information for FMU #2 is the same as found in FMU #1.

3. Fire Management Unit #3: The Chisos Mountains, designated as a Special Treatment Unit contains approximately 39,000 acres. Wildland Use Fires may be allowed within prescription depending on site, or suppressed until research results indicate likely outcomes. These proposed research fires are aimed at supporting science-based management in the park. Fire effects will be monitored with respect to sensitive species and habitats, at differing intensities, and in different seasons. This information builds on work begun in the late 1970s and early 1980s and will allow more informed management decisions on the reintroduction of wildland fire into sensitive habitats and landscapes, help facilitate the restoration of native grasslands, possibly maintain and enhance habitat of listed species, and contribute to the control of invasive exotics in concert with other measures.

a. Physical and Biotic Characteristics of FMU #3: The boundary is within the Vernon Bailey to Pulliam Ridge Rim, east of Route 14, South of Route 13 and Route 12, west of Glen Springs Road, and north of Juniper Canyon Road. Then the FMU boundary goes up to the NE Rim, the South Rim and along the rim of Ward Mountain, then across to Vernon Bailey. This FMU contains the bulk of the Grassy Woodland and Forest Vegetation Types.

Vegetation Types -- Chisos Mountains

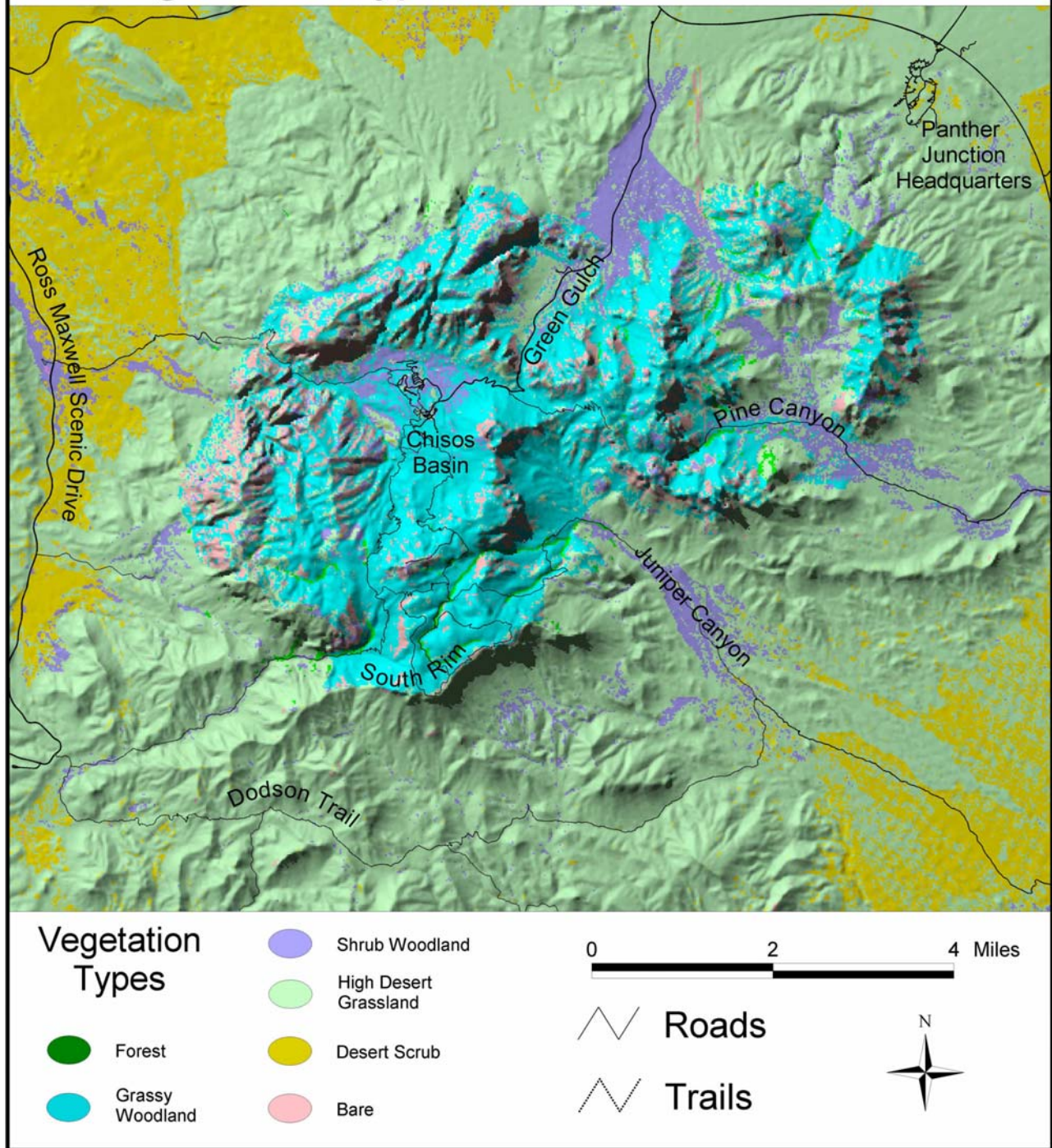


Figure III-5 Vegetation Types – Chisos Mountains

Vegetation Categories of FMU #3:

1. *Scrub Desert (occurs in FMU #1; #2 and #3):* This vegetation description and the management considerations is the same as described in FMU #1.
2. *High Desert Grasslands (occurs in FMU #1; #2 and #3):* This vegetation description and the management considerations is the same as described in FMU #1.
3. *Shrub Woodland (occurs in FMU #1 & #2 and FMU #3) :* This vegetation description and the management considerations is the same as described in FMU #1.
4. *Grassy Woodlands (FMU #3):* Grassy Woodlands contain three cover-mapping categories from Plumb (1993). These are Piñon-Juniper-Grass, Piñon-Oak-Juniper, and Forest-Meadow. These categories are found approximately 5,500 ft to 7,200 ft with more than 16 inches annual rainfall.
 - a. Common species: Mexican piñon, redberry juniper, weeping juniper, alligator juniper, gray oak, Graves and Emory oaks. Understory of *Salvia* spp., Harvard agave, silk-tassel, bull muhly, piñon rice-grass.
 - b. Grassy Woodlands has the following characteristics:
 - *Present structure:* This category shows canopy closure revealed in an examination of black and white aerial photography between 1962 and 1991 by park staff. Fire-scar data suggest more frequent fire (11 year interval during the 150 year study period) in the past prior to the grazing and suppression era (Moir 1982). General observation of the landscape shows frequent fire-scarred alligator junipers and charred woody debris on the ground. More severe fires would have consumed trees rather than leaving abundant scarring, suggesting fires were grass carried, relatively fast-moving and of low intensity.

- *Fire Regime Condition Class: II*
- *Condition on recent burns:* Fires larger than 100 acres include the Laguna Meadows (1980, 202 acres) and Casa Grande (1999, 230 acres). All were human caused and facilitated by the recovery of fine fuels at mid to high elevations.
- *Fire Cause and Frequency:* The present abundance of fine fuels would support landscape scale fires but they have not occurred. Lightning strikes may have been extinguished by rainfall or contained by topography, or played a part in a cycle involving climate, species and anthropogenic factors. Moir (1982) conservatively estimated a fire-return interval ranging from 9 to 70 years.
- *Fuel model: 2* - primary carrier of fire is now grass. Fire spread is from fine cured herbaceous fuels in addition to litter and downed stemwood. Open shrub lands, scrub oak and some juniper-pine assemblages fit this model.
- *Insect/disease:* Caterpillar damage on oaks.
- *Problem invasives:* None at present. Native bee brush has colonized areas disturbed by grazing.

Management considerations: Major goals are to manage this vegetation assemblage for ecological processes by allowing fires to burn within prescriptions at low and moderate intensities; protect sensitive resources where mandates direct; and, conduct research burns to learn more about fire effects and fire dynamics. Staff desires species diversity to be retained and fuels reduced. Monitoring will document fire effects and species diversity, particularly from research burns.

5. *Forest (FMU #3):* The Forest category contains two cover-mapping categories from Plumb (1993). These are Piñon-Talus and Oak-Ponderosa Pine-Cypress. Forest occurs above 6,000 ft where annual precipitation exceeds 16 inches. It forms a mosaic of conifers and grassy woodlands with various other species. The abundance of dissimilar taxa was one reason for the UNESCO Biosphere Reserve designation in 1976.

Common species: Mexican piñon, Graves oak, redberry, weeping and alligator junipers.

Distinct populations: Arizona cypress and Douglas-fir in Boot Canyon, red oak in the Western Chisos; quaking aspen on NW side of Emory Peak; one lateleaf oak and small numbers of netleaf oaks in the high Chisos; Texas madrone on north slopes and canyons, and Chisos hophornbeam on slopes north of Emory Peak and Crown Mountain, in Boot Canyon, and also near Pinnacles Trail and upper Cattail Canyon.

Less common species: ponderosa pine in Boot Canyon, Pine Canyon and Crown Mountain; bigtooth maple in canyons and north-facing slopes; orchid of all species scattered throughout the Chisos; and Guadalupe fescue on the moist slopes of Boot Canyon.

Forest has the following characteristics:

- Present structure: Fuel loads are high with continuous duff of 6-8 inches in places, 5-10 tons/acre standing dead and downed
- Fire Regime Condition Class: II or III
- Condition on recent burns: Fire is expected to burn in this assemblage but it has not.
- Fuel model: 10 (considerable litter and 3 tons/acre dead and downed; high-severity fire likely burning soil organic matter, soil seed reserves, and canopy; stand conversion possible from forest to oak shrubland).
- Fire Cause and Frequency: Lightning caused in the past. Fire frequency estimates are currently being evaluated by the National Park Service and Yale University. Moir's Fire History Study (1982) samples of fire scars in Boot Canyon recorded a 17 year fire interval during the 150-year period.
- Insect/disease: Standing dead has some insect and disease damage; some death from variable oakleaf caterpillar. Damage may also have resulted from drought stress.
- Problem invasives: No problems at present.

Management considerations: Management challenges abound in this category. A mosaic of relict, sensitive, and charismatic tree species and other rare species

covers the steep, largely roadless Chisos. Any high-severity fire in these fuels would require heavy-handed suppression to save existing rare, threatened, or otherwise special plants. Where possible, fire would burn to natural boundaries such as cliffs or talus slopes, trail or roadway, ideally at low and moderate intensities. Management tactics should use hand tools only in this wilderness area. The challenge is how this is to be done. Research fires to understand fire dynamics will reveal how to safely reduce fuels in forest vegetation. Monitoring efforts will be applied to natural, research, and prescribed fire in this vegetation category to document species diversity and understand fire effects and dynamics in particular species, habitats, and terrain. Vancat (Grand Canyon NP Fire Ecologist, personal communication October 2004) proposes that high-severity fire has not occurred in the North Rim of the Grand Canyon's mixed conifer forests because of heterogeneous topography. This scenario offers a possible explanation for the lack of fire in the Chisos despite abundant lightning strikes and heavy fuels. Research burns will be associated initially with mesic environments which represent late successional stages in forests and most likely to indicate effects of fire in valued habitats.

b. Fire Management Objectives specific to FMU #3:

Protecting people and property objectives:

- Prevent injuries to the public, staff, and fire personnel.
- Reduce fuels that threaten life and property using prescribed fire and mechanical fuel reduction methods.
- Prevent human-caused wildland fires through public education.
- Maintain safe egress (by hazard fuel reduction, fuel breaks, etc.) from all areas of the park in case of fire.
- Incorporate appropriate fire management tasks into all park divisions.

Cultural resources objectives:

- Properly plan each activity with resource managers.
- Conduct pre-action surveys.
- Carefully apply burning prescriptions.
- Suppress fires that fail to meet management objectives.
- Use minimum impact suppression tactics [MIST].
- Confer with resource advisors.
- Take advantage of surveying opportunities during and after fire operations
- Restore and/or maintain cultural landscapes.
- Use prescribed fire to reduce fuels around sensitive sites.

Natural resource management objectives:

- Properly plan each activity with resource managers.
- Determine the natural range of variability of the fire-return intervals.
- Determine desired conditions and condition classes for vegetation categories.
- Use fire as a restoration tool or as a maintenance tool.
- Monitor results of fire program activities and adjust management based on new knowledge.
- Where possible, ultimately allow fire to resume its natural role in park ecosystems.
- Carefully apply burning prescriptions.
- Suppress fires that fail to meet management objectives.
- Use minimum impact suppression tactics (MIST).
- Confer with resource advisors.
- Take advantage of surveying opportunities during and after fire operations
- Use prescribed fire to reduce fuels around sensitive sites.
- Fire Management activities are conducted in accordance with applicable terms and conditions established in the Biological Opinion (Appendix D.) issued by the U.S. Fish and Wildlife Service.

c. Management Considerations:

Specific management considerations are outline for each vegetation type in the vegetation type description. FMU #3, the Special Treatment Unit, allows for the measured introduction of low to moderate intensity wildland fire particularly in the Chisos based on the results from research burns. These results provide

the stepping-stones to understanding how to reintroduce fire safely into a landscape following overgrazing prior to the park establishment and 60 plus years of a fire suppression management policy. This management approach acknowledges that historical vegetation communities, and fire return intervals are not well documented and a more careful, research-based approach to introducing fire is warranted. Resource managers also acknowledge that fuel levels will continue to increase in the Chisos while research results are being understood and that a stand-replacing fire could occur before research results are applied.

d. Historic role of fire: This information for FMU #3 is the same as found in FMU #1

e. Wildland Fire Management Situation

1) Historical Weather Analysis: This information for FMU #3 is the same as found in FMU #1

2) Fire Season: This information for FMU #3 is the same as found in FMU #1

3) Fuel Characteristics: Forest vegetation type fuel loading is heavier than average indicated for Fuel Model. Vegetation surveys have reveals a saturation of seedlings and saplings of pine and juniper in High Chisos.

4) Fire Regime alteration: The fire regime information found in FMU #1 (except Floodplain/Upland Riparian) applies the FMU #3. Also, it is possible that some compositional change has occurred in the Shrub Woodland, Grassy Woodland, and Forest vegetation types due to fire suppression. The latest landscape scale fire was recorded over 100 years ago.

5) Control Problems and dominant topographic features: Control problems could range from low to extreme depending on site and burning conditions. Spring winds are normally very strong, which greatly increases fire spread. The largest fires to date have been associated with inappropriate visitor use (abandoned campfires). A vegetation pattern, in particular the Oak canopy that cures over winter and remains on trees until late spring, presents a special problem. The mountain terrain influences local wind patterns, accessibility, vegetation density

and fire spread rates up steep slopes. Natural barriers are present and will be used when available.

6) Other elements of fire environment: Two endangered species (Mexican long-nose bat and black-capped vireo) habitat are limiting factors to the amount of fire spread. The paucity of available firefighting resources requires consideration of greater Initial Attack risks during elevated fire danger situations. The park is designated a Class I air shed. The unknown location of many cultural sites requires minimal ground disturbance.

IV WILDLAND FIREMANAGEMENT PROGRAM COMPONENTS

A. GENERAL IMPLEMENTATION PROCEDURES

Implementation of Wildland fire management components must be consistent with fire management capabilities and should consider the current and predicted conditions affecting fire behavior. Preplanned decisions based on historical fire behavior indices should be considered to most efficiently aid in Stage 1 decisions requiring appropriate management response.

Fire managers will use these strategies for expediting the decision-making process when determining whether to respond to an initial attack as an emergency or if Wildland fire ignition will be used for resource benefit.

A Wildland Fire Implementation Plan (WFIP) will be initiated for all Wildland fires. The WFIP Stage 1 will be prepared by the Initial Attack Incident Commander (ICT4) or Duty Officer based on information provided by the fire size-up. The Stage 1 is the initial stage of the planning process.

The WFIP Stage 1 includes the Strategic Fire Size-Up, Decision Criteria Checklist, Management Actions and the Periodic Fire Assessment. This process will be completed within 8 hours of confirmed fire detection and Strategic Fire Size-Up. The Appropriate Management Response (AMR) decision criteria will be based upon the criteria for the appropriate Fire Management Unit where the fire is located. The full range of natural and cultural resource considerations identified by Fire Management Unit should be considered while determining the AMR.

In FMU #1, where suppression is the only appropriate response, the requirement for a decision checklist as part of the Stage 1 analysis is considered to be met. Subsequently, the Stage 1 analysis may often be satisfied at the programmatic level in the FMP through determinations made by combinations of values to be protected and/or fire behavior thresholds.

B. WILDLAND FIRE SUPPRESSION

1. Range of Potential Fire Behavior: Fuel models present in Big Bend derived from Anderson (1982)

1 = Fire spread is governed by fine, porous and continuous herbaceous fuels that are almost cured. Typical of grasslands and grass-shrub assemblages and has high rates of spread. Scrub Desert (may require calibration due to sparse fuels)

2 = Fire spread is from fine cured herbaceous fuels in addition to litter and downed stemwood. Open shrub lands, scrub oak and some juniper-pine assemblages fit this model. High Desert Grasslands (HDG), Grassy Woodlands (HDG - may require calibration due to sparse fuels)

3 = Fire is carried through tall grasses where one-third or more are considered cured or dead. Highest intensity of the grass fires, especially under wind. Riparian Giant Reed and Common Reed

6 = Fire carries through the shrub layer at moderate wind speeds (8 mi/hr) but drops to the ground at lower speeds and breaks in the canopy. Shrub Woodlands

8 = Slow-burning ground fires with low flame lengths. The fire-supporting layer is composed of compact leaf litter, needles, leaves and twigs. Riparian Mesquite and Tamarisk Stands;

10 = In addition to leaf litter there are up to 3 tones per acre of downed dead material. Fires can be intense burning at ground and canopy level and be difficult to control. This model is characteristic of the Forest vegetation category. (may require calibration due to heavy fuels loads)

Potential fire behavior in Big Bend National Park can range from a creeping surface fire, with flame lengths of less than half a foot and spread rates of 0.1 chains/hour, to a sustained crown fire, with flame lengths in excess of 30 feet and spread rates of 360 chains/hour, depending on fuel type. Fire behavior is directly influenced by season, weather, fuel characteristics, and topography; fires burning during the monsoon rains tend to burn slower and with less intensity than fires burning before the monsoon season or in the late fall. Seasonal curing, as related to fuel moisture and fuel arrangement, plays critical roles in determining potential fire behavior in all vegetation types.

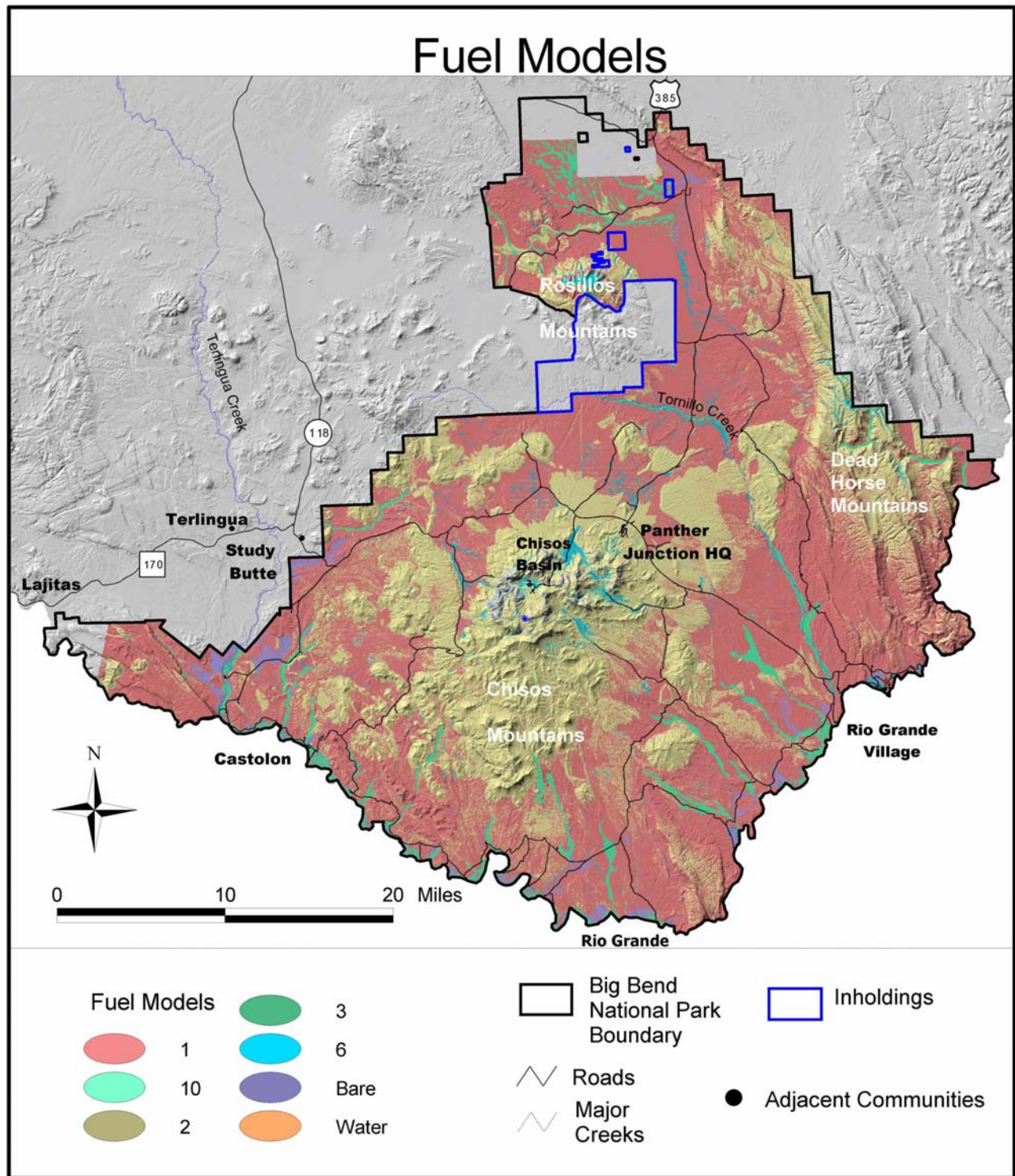


Figure IV-1 Fuel Models

2. Preparedness Actions

a. Fire Prevention Activities: Wildfire prevention is the responsibility of all park divisions, employees, visitors, cooperators,

and concession personnel. Prevention must include public education, safety inspections, enforcement of regulations, hazard fuels management, and related activities. Because wildfires readily cross political boundaries, close cooperation with adjacent state and private landowners is essential. Accomplishment of key prevention tasks outlined in Table IV-1 will substantially reduce the risk or severity of wildfire.

Table IV-1 Fire Prevention Tasks

Task	Responsibility
Plan for Prevention:	
Develop cooperative agreements and memoranda of understanding with private in-holders and adjacent land managers.	Chief, Visitor and Resource Protection
Annually review, revise and implement the cyclic fuel treatment plan.	Fire Management Officer
Annually review prevention analysis following NPS Wildland Fire Prevention Handbook Guidelines	Fire Management Officer
Conduct fire hazard inspections of all facilities prior to fire season.	District Rangers
During periods of high or extreme fire danger, ensure that all ranger patrols are equipped for initial attack; enforce Superintendent's closures and restrictions.	Chief, Visitor and Resource Protection
Increase Public Awareness:	
Include an adequate wildfire prevention message on all backcountry permits and handouts. This should include the rationale for Wildland Fire Use and management ignited prescribed burns.	Chief, Interpretation and Visitor Services
Construct fire danger warning signs and place at Persimmon Gap, Chisos Basin, and the Panther Junction Visitor Center.	Chief, Facility Management

During periods of high or extreme fire danger, issue news releases to local media. Include prevention information and campground and backcountry restrictions; advise day-visitors through visitor center staff and the traffic information radio (TIS). Advise employees and their families.

Chief, Interpretation and Visitor Services

Increase Employee Awareness:

Place fire danger warning sign at entrance to employee housing at Panther Junction.

Chief, Facility Management

Broadcast high or extreme fire danger warnings on park radio.

Park Communications Center

Train employees, their families and residents in prevention and survival.

Fire Management Officer
Park Safety Officer

Conduct annual evacuation drill of Chisos Basin Developed area.

District Ranger
Concession Manager

In addition to the above tasks, Big Bend National Park has been divided into ten wildfire prevention zones based upon hazards (fuels), values (developments), and risks (ignition potential). The park's Fire Prevention Plan (Appendix I) contains detailed descriptions of tasks designed to promote fire awareness, reduce human-caused ignitions, reduce structure damage, and improve public and employee safety.

Fire prevention activities at Big Bend National Park has consisted primarily of public contacts in the park and evening programs in the Rio Grande Village, Chisos Basin and Panther Junction areas. Under this plan, the campaign will expand to target private landowners adjacent the Park. Fire-wise, a non-profit organization that promotes fire prevention and preparedness will be the basis for this campaign. The campaign will include an annual open house at the Panther Junction Fire Management Office, a Firewise library, and annual mailings.

Big Bend National Park observes extreme fire danger each spring. A public closure to smoking on trails in the High Chisos and charcoal

fires in campgrounds is enforced from approximately April 1 to the end of fire season. Such restrictions are posted on the bulletin boards at visitor centers as well as the campsite registration bulletin boards at the Chisos Basin Campground. During the fire season, firefighters regularly patrol the established campgrounds and occupied campsites and advise visitors of fire danger conditions. The majority of the contacts are made during the late winter and early spring as visitor use increases prior to and during Spring Break.

b. Fire Training: The National Wildfire Coordinating Group incident qualification and training standards will be followed. Training is a year-round effort to support the interagency qualification and certification standards.

Table IV-2 Annual Training Calendar

Month(s)	Training Activity
January-April	Mandatory 8-hour Wildland fire safety refreshers and work capacity test (pack test) Fire Shelter Deployment practice Cultural resource awareness training
April-October	Local on-going operations training Daily "Six Minutes for Safety" sessions Weekly drills and hose lays Monthly fire shelter deployment practice S/I-100 and 200-level courses based on local needs Class B firefighter exemption driver training Interagency Aviation User Training (B-3)
May	Training Needs Analysis development - courses identified for upcoming training season
September-October	Training Course calendar development Apply for Regional/National training slots TX Wildfire Academy training classes occur
November 1	Course nominations to NARTC training center
November-December	National Training classes occur.

c. Fire Season Readiness: Interagency Fire Readiness Reviews are conducted annually in late March or early April. The reviews include all aspects of fire operations, including facilities, equipment, training, record-keeping, and cache inventories. Performance drills are also conducted and include fire shelter deployments.

After action reviews are conducted after every fire incident following the standards found in the Incident Response Pocket Guide.

Most fire equipment and supplies are stored and maintained at Panther Junction (park headquarters). Outlying developed areas (Chisos Basin, Rio Grande Village and Castolon) maintain small fire caches to support local Initial Attack. The Panther Junction cache inventory is maintained by the designated Cache Managers and has sufficient supplies and equipment to fully re-stock both Type 6 engines at once, and additional personal protective equipment and tools for 100 firefighters. Access to the fire cache is limited and all supplies and equipment are considered accountable to assure that adequate supply levels are maintained. Defective, unsafe or worn-out items should be turned in to one of the Cache Managers for replacement. All individuals who carry fire gear with them are responsible for assuring that it is serviceable and fire-ready at all times, including monthly fire shelter inspections.

Table IV-3 Annual Readiness Activities Calendar.

Month(s)	Readiness Activity
January-February	Order training materials for upcoming local courses Submit Mobilization Guide updates Annual inspection of helispots (refer to RM 60 & IMR aviation)
February – March	Inventory cache and order replacement supplies/ equipment Order crew uniform t-shirts/sweatshirts Conduct pre-season risk analysis Confirm radio frequencies and programming with cooperators
April	Confirm local vendor availability Obtain current EERA’s from Lincoln Zone Coordination Center National & Regional Mobilization Guides issued Annual Big Bend readiness review
April-October	Conduct daily “6 minutes for Safety” sessions Conduct weekly readiness drills Maintain cache inventory Maintain equipment in fire-ready condition Replace/rehab supplies/equipment used on incidents Conduct after-action reviews for all incidents
November - December	Refurbish all equipment, including radios Conduct annual engine maintenance Review Fire Management Plan and its appendices, revise as necessary Annual Lincoln Zone Operating Plan review and update

d. Fire Weather and Fire Danger:

1) Weather Stations The Panther Junction (417401) and Chisos Basin (417403) stations are remote automatic weather stations (RAWS) located within the Park. Appendix J has Weather Station Catalogs. Both stations are manufactured by FTS and the sensors are maintained by BIBE fire personnel through the RAWS depot at the National Interagency Fire Center (NIFC) in Boise, Idaho. The stations collect, store and transmit hourly weather data. The Panther Junction (417401) station is located on the north side of the Chisos Mountains at 3,785 ft. Thresholds are identified using fuel model L, T and G. The 417403 (Chisos Basin) station is located in the Chisos Mountains at 5,400 ft. Thresholds from this station are identified using fuel models L, F, H and G.

2) NFDRS: The National Fire Danger Rating System (NFDRS) uses daily fire weather observations and forecasts to produce indices that estimate current and forecasted fire danger throughout the United States. The system is designed to produce “worst-case” outputs based on hot, dry, windy conditions.

The best overall indicator of fire danger rating in this area is the burning index. This index takes into account the Spread Component which is used for light fuels that dry quickly and are affected most by the wind, but also incorporates the energy release component which is influenced by heavy fuels and long-term seasonal drying. Since the burning index reflects both short and long-term drying, but also accounts for the daily affect of wind on the fuels, it is a better indicator overall of general fuels conditions in a broad area.

Figure IV-2 plots the 10-day average Burning Index (BI) and the percentile ranking. The fuel type L represents western perennial grasslands (High Desert Grasslands). This fuel model covers approximately 38% of the park, and is the high-risk-potential carrier of wildfire into the higher elevations and heavier fuels. Beginning March 1, the average 10-day BI begins to exceed the 50th percentile (a Staffing Class III, High Fire Danger). The BI remains above the 50th percentile through May 30. May is the first month of the wet season, and June 1 is the average green up day for perennial grasses which drops the fire risk. Heavy visitation begins at Big Bend

about March 1, increasing the risk of human-caused ignitions substantially. Typically, visitation drops dramatically after the Spring Break-Easter period. Lightning becomes the primary ignition source from May through September. May, June and July are generally hot months and pre-monsoon precipitation, conditions suitable for large, lightning-caused fires.

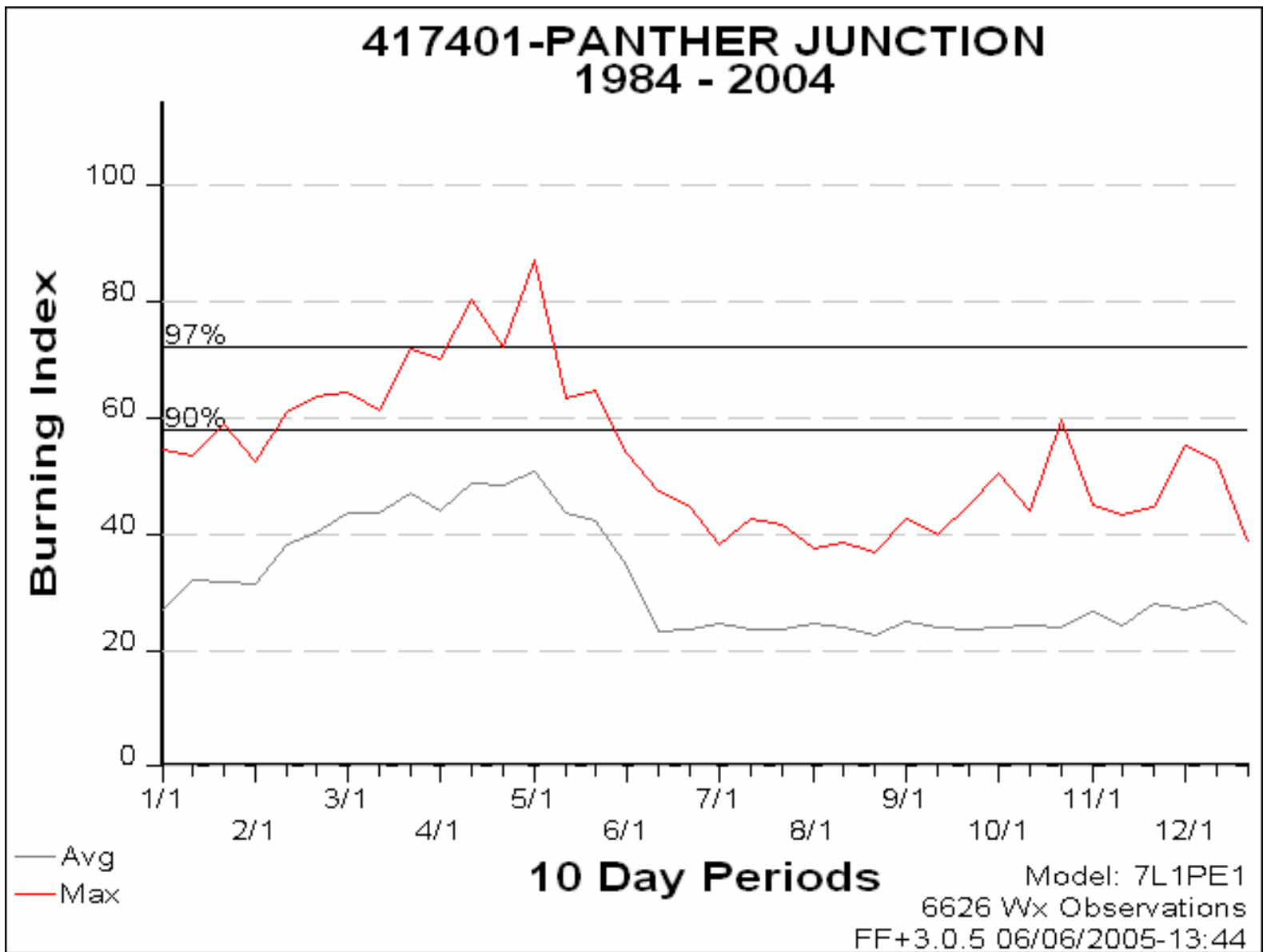


Figure IV-2 Ten-Day Moving Average Burning Index

The process for developing NFDRS thresholds was through the use of Fire Family Plus (v 3.0.5). Twenty years of weather data (1984-2004) for Panther Junction was analyzed. The process for communicating fire danger information to field personnel is through the use of Pocket Cards, updated annually. The Pocket Cards permit field personnel to calculate the daily BI to the historic average. The fire danger is radio broadcast to all personnel via park dispatch and it is posted with the Daily Report at visitor contact points throughout the park

e. Step-up Staffing Plan:

**Table IV-4 Step-up Plan for Big Bend National Park
Burning Index for Fuel Model L
Panther Junction**

<u>Staffing Classes</u>	<u>Burning Index</u>	<u>Fire Danger Adjective Rating</u>
I	0 - 29	Low
II	30 - 42	Moderate
III	43 - 53	High
IV	54 - 67	Very High
V	≥68	Extreme

Management Actions

Staffing Class	Burning Index	Step up Action
SC-I	0 - 13	<p>All seasonal and permanent employees are assigned normal tours of duty at designated stations.</p> <p>Equipment and supplies will be inventoried and serviced.</p> <p>Daily fire weather will be collected at 1300 hours and processed in the WIMS system. Indices and components are computed.</p> <p>Any reported ignitions will be received by the dispatch center. Dispatch will immediately notify the Fire Crew, FMO and the appropriate District Ranger. The ignition point will be located and evaluated, and the proper response taken.</p>
SC-II	4 - 28	<p>Pumps/engines are checked monthly.</p> <p>All equipment is maintained in a ready state at the fire cache at Panther Junction and at District caches.</p> <p>If cloud-to-ground lightning activity occurs, detection flights may be made and a declaration of Staffing Class III determined, if appropriate.</p>
SC-III	29 - 58	<p>Resources and their locations are tracked by Fire Management and Park Dispatch.</p> <p>All fire-qualified personnel will maintain a personal fire pack at a ready state.</p>

Management Actions

Staffing Class	Burning Index	Step up Action
		<p>The wildland fire engines, structural fire engines and all portable pumps will be checked and operated once a week.</p> <p>Red-carded personnel will carry daypacks and initial attack tools in their vehicles.</p> <p>During holidays, weekends, or other periods with an expected increase in visitation and increased ignition risk, e.g. spring break, step-up to SC IV is appropriate.</p> <p>Step up to SC-IV if there are any active fires in the park.</p> <p>Step up to SC-IV if cloud-to-ground lightning activity occurs or if LAL (predicted or actual) is rated at 4, 5 or 6.</p>
SC-IV	59 – 83	<p>Fire Management Officer, will request the Park Superintendent to approve emergency preparedness funds for personal services (premium pay) and detection flights (park aircraft). FMO will notify IMR, Branch of Fire and Aviation Management. Each request, response, and justification will be documented.</p>

Management Actions

<u>Staffing Class</u>	<u>Burning Index</u>	<u>Step up Action</u>
		<p>Lincoln Zone Interagency Dispatch will be advised of status. TX Forest Service will be advised of status.</p> <p>All on-duty fire qualified individuals will be advised of fire danger rating.</p> <p>Upon advice of the Fire Management Officer, a 6- or 7-day workweek for fire-qualified staff may be initiated and tours of duty may be extended. Scheduled annual leave may be canceled.</p> <p>All on-duty personnel will remain alert to the presence of smoke and/or potential ignition sources. Efforts will be taken to eliminate potential ignition sources; smokes will be reported immediately to Park Dispatch. Fire Crew will be dispatched.</p> <p>When cloud-to-ground lightning activity is reported, a detection flight will be scheduled as soon as safely possible.</p> <p>Visitor center staff will be advised of fire danger rating; park visitors will be informed of fire danger conditions.</p> <p>All backcountry permits issued will have red fire danger warning cards attached to the permits. Backcountry users will be informed verbally at all visitor centers. Advisory notices will be posted at all visitor centers and other prominent locations.</p>

Management Actions

Staffing Class	Burning Index	Step up Action
		<p>Backcountry coverage will be increased, if feasible.</p> <p>At the discretion of the Fire Management Officer, an IA dispatcher may be assigned until fire danger subsides.</p> <p>Step up to SC-V if there are any actively spreading fires in or threatening the park.</p> <p>Step up to SC-V if cloud-to-ground lightning activity occurs or if LAL is rated at 4, 5, or 6.</p> <p>Additional emergency firefighters may be hired.</p> <p>Notify park neighbors and cooperators of fire danger and request cooperation.</p>
SC-V	84 +	<p>Contact Lincoln Zone Interagency Dispatch Center regarding availability of crews and air resources.</p> <p>Contact Texas Forest Service regarding availability of crews and air resources.</p> <p>The IMR Fire Management Officer will be informed of status changes.</p> <p>Issue closures on all or parts of the park as recommended by the Chief Ranger and approved by the Superintendent.</p>

Management Actions

Staffing Class	Burning Index	Step up Action
		At the discretion of the Fire Management Officer and with concurrence of the Superintendent, place park personnel on ordered stand-by duty; tours of duty may be extended.
		A helicopter and module for IA may be requested and employed for stand-by duty.
		Stage personnel in critical areas to facilitate rapid response to ignitions.
		Prohibit outdoor cooking in campgrounds and at residences.

NOTE: Levels of preparedness are progressive and include actions established at the lower levels. An emergency Step-up Plan funding account is the funding source for Step-up Plan actions. The Superintendent has the authority to approve this expenditure. Very High and Extreme Staffing Class conditions extending for long-term (i.e. 30 days) is an indication to consider a Severity Funding Request and the staging of additional resources. The regional office has the authority to approve this expenditure.

3. Pre-attack Plan: Big Bend National Park Pre-attack information is placed within Appendix G of this Wildland Fire Management Plan. The Pre-attack Plan contains lists of facilities, base camps, water sources, helispots, and other data pertinent to Type 3 and more complex Wildland fire incidents. Information such as contact numbers and names must be updated as changes occur.

4. Initial Attack: Suppression includes all actions taken to limit the growth of wildfires and extinguish them. All naturally caused fires not classified as Wildland Fire Use and all human-caused fires, excluding

management ignited prescribed fires, are wildfires. Wildfires must receive prompt, effective, and efficient suppression treatments selected to minimize resource damage in a cost-effective manner.

An Incident Commander (IC) will be designated for each wildfire. Upon arrival at the fire, the IC will complete an incident size up report (as suggested in Incident Pocket Response Guide or Reference the Redbook for detailed fire size-up checklists) and provide the information to the Big Bend Communication Center. Park Dispatchers are responsible for passing the report information to Wildland Fire Duty Officer, Park Information Officer and Chief Ranger. In the event of fires requiring resources beyond the fire suppression capabilities of the Park, the IC may request additional resources via Lincoln Zone Coordination Center.

a. Initial Attack Priorities

The top priorities for Initial Attack response are:

1. Wildland/Urban Interface
2. Known Cultural Resource Sites
3. Special Treatment Unit
4. Other natural resources at risk

b. Initial Attack Response Criteria:

- Public and firefighter safety.
- Protection of improvements and private property.
- Protection of cultural, historic, and natural resources.
- Minimum fire-line construction and use of Minimum Impact Suppression Tactics (MIST).
- Available suppression resources and response times.
- Fire behavior as determined by fuels, weather, and topography.

Use aircraft and mechanized equipment only where necessary to support above-listed criteria.

The IC is responsible for all actions taken on fires, including operations, plans, logistics, and finance. Qualified staff from all park divisions may be utilized for initial attack and extended operations. It may be necessary to curtail normal operations

during periods of fire activity. Except for life-threatening emergencies, response to wildfire is of highest priority for action. Response by park staff to wildfire takes precedence over all other normal park activities.

c. Confinement: A confinement strategy may be implemented during attack action to maximize firefighter safety, minimize suppression costs, or maximize availability of critical suppression and management resources to protect values at risk threatened by other fires in the Park. It may not be used to meet resource objectives. Confinement can also be a strategic selection through the Wildland Fire Situation Analysis process when the fire is expected to exceed initial attack capability or planned management capability. A long-term implementation plan is needed to guide the implementation of the confinement strategy. The WFIP prepared in stages, meets this requirement.

d. Fire Response Times: During the designated fire season (March 1 – July 15) and during duty hours (0900-1730) the wildland fire engines at Panther Junction are expected to maintain ten-minute readiness for responses within the Park. Outside of duty hours, a one-hour response is maintained.

Table IV-5 Fire Program Resource and Response Times

Resource Type	Response Time	Time of Year
Overhead	30 minutes	January 1 – March 15
Initial Attack Resource	30-45 minutes	
Reconnaissance Aircraft	1-1.5 hours	
Overhead	30 minutes	March 16 - September 30
Initial Attack Resource	10-20 minutes	
Reconnaissance Aircraft	1-1.5 hours	
Overhead	30 minutes	October 1 – December 31
Initial Attack Resource	30-45 minutes	
Reconnaissance Aircraft	1-1.5 hours	

e. Restrictions and Special Concerns: The park has identified a general set of restrictions and concerns for the fire management program at Big Bend. For specific incidents, a Delegation of Authority (Appendix M) will be developed that allows the Superintendent to turn over fire management activities to an Incident Management Team. It will include those specific restrictions and critical concerns for the management team that will include key cultural features, key resource concerns, restrictions, approved tools, and will identify agency representatives and advisors. Listed below are the general restrictions and concerns that will apply to any fire management action:

- Provide for firefighter safety.
- Manage incident with appropriate suppression response actions that cause minimal resource damage.
- Manage the fire cost-effectively for the values at risk.
- Provide training opportunities for the park personnel and other cooperators to strengthen organizational capabilities.
- Provide for minimum disruption of visitor access, consistent with public safety.

f. Issues:

1) Wildland Fires in Mexico: Initial Attack of threatening wildfires in Mexico within a 16 kilometers (10 miles deep) "Zone of Mutual Assistance" is possible through the authority provided in the USA/Mexico Wildfire Protection Agreement (2004). The purpose of this Agreement is to enable wildfire protection resources originating in the territory of one country to cross the United States-Mexico border in order to suppress wildfires on the other side of the border within the zone of mutual assistance in appropriate circumstances. Approximately 1 million acres in Mexico is subject to Initial Attack fire protection. The Wildfire Suppression Assistance Act of April 7, 1989, Public Law 101-11 (42 U.S.C. §§ 1856m – 1856o) provides the authority for the United States of America to enter into the Wildfire Protection Agreement with Mexico.

2) Los Diablos Program: Currently, thirty-nine men (Mexican Nationals) participate in a Wildland Firefighting Program that started in 1990. The remoteness of the park from other USA firefighting resources created the need to find resources nearby. All participants are NWCG qualified. The program has served as an example of co-operation between land management agencies of the two countries.

With assistance from Department of Homeland Security, the Customs and Border Protection Agency, the Diablos are eligible for parole into the United States on an annual basis to assist any emergency firefighting effort in the company of Big Bend National Park staff.

This wildland firefighting assistance from Mexico is in jeopardy with the current border closure at all locations except Port of Entry. Personnel changes in the DHS agency could end the critical support to the Diablo Program. A formal agreement is needed between agencies.

3) Wilderness Considerations: In 1973 a total of 533,900 acres, mostly roadless desert and mountain country were recommended to Congress for wilderness designation, and an additional 27,000 acres were recommended as potential wilderness. The proposal was eliminated from the National Parks Omnibus Bill in the 1978 session of Congress. Even though the proposal was not acted upon by Congress, the recommended area must be managed by the National Park Service in a manner which will not destroy its future suitability for wilderness designation. (NPS Policies 2001)

Management of wilderness is guided by Director's Order #41, Wilderness Preservation and Management (1999). The order directs "Potential disruption of wilderness character and resources and applicable safety concerns will be considered before, and given significantly more weight than, economic efficiency and convenience. If a compromise of wilderness resources or character is

unavoidable, only those actions that have localized, short term adverse impacts will be acceptable.”

Certain fire management activities must be carefully evaluated before implementation within designated wilderness. Generally, these activities include the use of motorized equipment or mechanized transport. Generally prohibited activities will be considered with a minimum requirements analysis. In the event that fire poses an imminent threat to life or property, fire suppression activities can be classified as “Emergency Needs” and, as such, do not require documented analysis prior to approval of a generally prohibited activity or use in wilderness. Authority for approval of emergency use of motorized access or mechanized transport can be re-delegated to the Fire Management Officer who must provide a written report with justification and alternatives considered to the Superintendent. Rationale for authorization will be documented and placed in the incident documentation file. Guidelines for such emergency decisions are as follows:

- A Resource Advisor will be assigned to all extended attack fires, including those occurring in or near wilderness.
- Fire camps and incident command centers will be located outside of wilderness. “Coyote” camps (minimum impact) will be permitted in the proposed wilderness.
- Throughout the Park, motor vehicle use is restricted to existing roads.
- Throughout the Park, hand lines will be located to make full advantage of natural barriers such as rock outcroppings, trails, and dry washes. Hand lines will be no wider than necessary to stop the spread of fire.
- Within wilderness chain saws, helicopters, or pumps will only be used when essential to meet suppression objectives, but with due consideration to impacts on wilderness character and subject to minimum requirements determination.

- Establishment of permanent helicopter facilities are not allowed in wilderness.
- For fire management purposes, it is generally possible to use unimproved helispots in wilderness and walk into the work site if such an unimproved helispot is available within a 30-minute walking distance. The decision to use a helispot in wilderness will be detailed in a Wilderness Minimum Requirements Analysis as well as an environmental compliance document (i.e., Environmental Assessment or Categorical Exclusion).

Additional details regarding aviation and wilderness can be found in the Aviation Plan.

WILDERNESS, Big Bend National Park

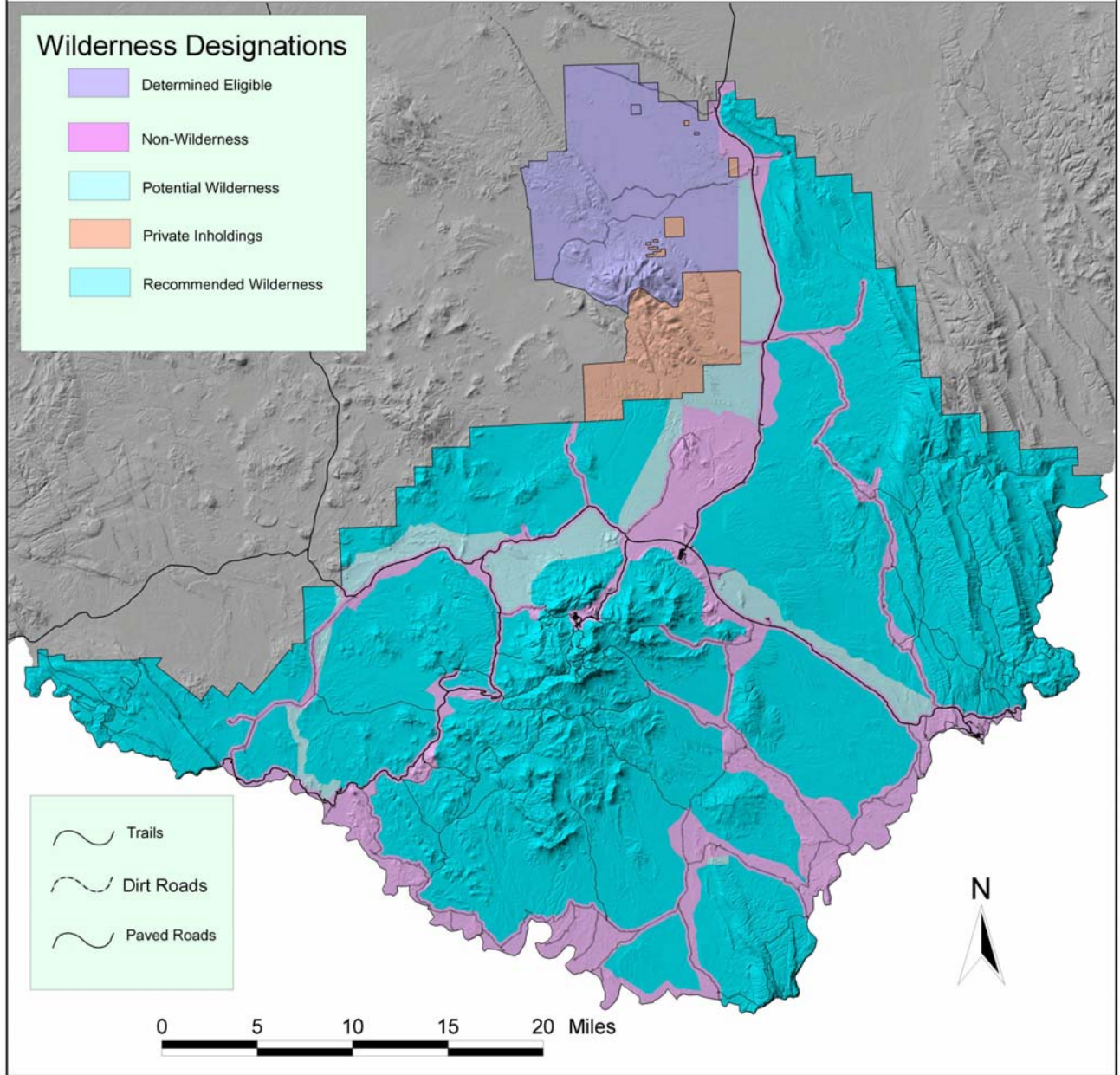


Figure IV-3 Proposed Wilderness Map

4) Aviation Management: There is a variety of aircraft used in fire operations within Big Bend National Park, and one fixed-wing aircraft is permanently stationed within the Park. This aircraft has Visitor and Resource Protection as a primary duty and the Aviation Management Program is managed separately from the Fire Management Program

It is the policy of Big Bend National Park to use its aircraft for activities involving life or health-threatening emergencies, the administration and/or protection of resources, research, and for individually approved special purpose missions. The objective of every flight is to be the safest, most efficient, economic and effective method of performing the required task, consistent with National Park Service goals. All administrative use of aircraft will comply with the policies and guidelines contained in the Departmental Manual 350-354, Director's Order/Reference Manual #60: Aviation Management (2003); applicable Aviation Management Directorate (AMD) policies and the operational procedures outlined in this plan. *Everyone* is responsible for becoming familiar with and applying correct procedures in all phases of aircraft use. The number one concern at all times is **SAFETY**.

For safety purposes, low altitude flights, helicopter or fixed wing, will be avoided to the extent practicable. Furthermore, low altitude flight directly over wild animals or areas of visitor concentration will be avoided at all times unless such an activity is the express purpose of the flight (e.g., wildlife census flights). An aviation hazards map is available from the Aviation Manager or at the Panther Junction helibase.

There are specific restrictions regarding the use of unimproved landing zones in designated wilderness. These restrictions and additional details of aviation management in Big Bend National Park are found in the Aviation Plan.

5) Extended Attack and Large Fire Suppression:

a) Extended Attack needs: Extended attack occurs when a fire has not been controlled by the initial attack forces or a complexity analysis is done by onsite resources that recommend a higher level of qualifications are needed for the complexity of the incident. Extended attack action requires a Wildland Fire Situation Analysis to guide the re-evaluation of suppression strategies.

When complexity levels exceed initial attack capabilities, the appropriate Incident Command System (ICS) positions should be added commensurate with the complexity of the incident. The Incident Complexity Analysis and the Wildland Fire Situation Analysis (WFSA) assist the manager in determining the appropriate management structure to provide for safe and efficient fire suppression operations. When additional positions are required for management of wildland fires, the FMO or Acting will coordinate orders with the Incident Commander (IC) and Lincoln Zone Coordination Center or expanded dispatch.

A unified command structure will be a consideration in all multijurisdiction incidents.

The Superintendent will approve the WFSA and any revisions.

b) Implementation Plan Requirements: The WFSA is a decision making process in which the agency administrator or representative describes the situation, compares multiple strategic wildland fire management alternatives, evaluates the expected effects of the alternatives, establishes objectives and constraints for the management of the fire, selects

the preferred alternative, and documents the decision. The format and level of detail required depends on the specific incident and its complexity. The key is to document the decision made. A WFSA will be completed whenever a fire escapes initial attack. The Agency Administrator, his/her representative, and the FMO or Incident Commander, prepares the WFSA.

An electronic copy of the WFSA can be found at www.fs.fed.us/fire/wfsa/

c) Complexity Decision Process: An Incident Complexity Analysis (Appendix N) will be used as a guide for IC's, fire managers, and Agency Administrators to evaluate emerging fires in order to determine the level of management organization required to meet agency objectives. This will assist in identifying resource, safety, and strategic issues that will require mitigation. There are two types of Incident Complexity Analysis available in Appendix L or M of the Redbook.

d) Delegation of Authority: Should an interagency IC or an overhead team be called for assistance, a Limited Delegation of Authority (Appendix M) will be completed. The Limited Delegation of Authority, signed by the park Superintendent, gives authority to the IC to suppress or manage the fire(s). Constraints identified in the delegation of authority, along with an Agency Administrator's Briefing Package, will provide essential information regarding the fire, legal responsibilities, and the park's resources to an incoming Incident Commander.

6) Exceeding Initial Attack: For the documentation of specific fire environment information (size-up) as well as identification of resources at risk and resulting decisions made to the appropriate suppression response the park has decided to utilize the form found in Appendix K. (This

form is stage 1 of a Wildland Fire Implementation Plan for those units that manage Wildland Fire Use Fires). Big Bend simply has chosen this form to document current fire information.

The WFIP Stage 1 Decision Criteria Checklist will be utilized to determine if an existing appropriate management strategy has been exceeded. With input from park staff, information from the Periodic Fire Assessment and upon completion of the Checklist, the Park Superintendent decides whether to initiate actions to manage the fire with the help of an Incident Management Team. Initial Attack efforts and activities that fail to confine, contain or control the fire beyond two operational periods (48 hours) will result as the fire exceeding initial attack.

7) Minimum Impact Suppression Tactics (MIST):

As required by NPS policy, minimum impact suppression techniques MIST guides selection of tools for managing fire. Wilderness areas in particular are to be managed in ways that minimize human impacts on the resource. Fire lines along natural barriers such as the river, roads, trails, cliffs and talus slopes are sought wherever possible, and disturbance to the landscape, cultural and other resources minimized. Suitable sites for staging areas and spike camps have been located in previously disturbed campsites and developed areas. Falling of trees will be minimized. Stumps will be flush cut and covered during Rehab. Agency resource advisors will be consulted prior to implementing management tactics.

8) Emergency Stabilization and Rehabilitation:

The Department of Interior Office of Wildland Fire Coordination has issued policy to authorize and provide the means for managing emergency stabilization and rehabilitation following wildland fire on lands or threatening lands under the jurisdiction of the Department of the Interior, or lands adjacent thereto (620 DM 3). The three primary components of this policy are listed below.

Emergency Stabilization: To determine the need for and to prescribe and implement emergency treatments to minimize threats to life or property or to stabilize and prevent unacceptable degradation to natural and cultural resources resulting from the effects of a fire.

Rehabilitation: (1) to evaluate actual and potential long-term post-fire impacts to critical cultural and natural resources and identify those areas unlikely to recover naturally from severe wildland fire damage. (2) To develop and implement cost-effective plans to emulate historical or pre-fire ecosystem structure, function, diversity, and dynamics consistent with approved land management plans, or if infeasible, to restore or establish a healthy, stable ecosystem in which native species are well represented. (3) To repair or replace minor facilities damaged by wildland fire.

Fire Suppression Activity Damage Repair: (1) To evaluate and plan fire suppression activity damage repair. (2) To fund and implement projects that meet specific Department of Interior criteria found in section 3.10 of 620 DM3 as well as agency administrator criteria.

The Burned Area Emergency Rehabilitation Plan for the park is found in Appendix L.

9) Records and Reporting: Fire reporting follows guidelines established by NPS policy and Directors Order 18 and the associated reference manual, RM-18 (NPS 2005). All fires, regardless of type, are required to have a written report, which is tracked at park and national levels. The following documents are included in this final wildland fire record:

- DI-1202, Individual Fire Report
- Narrative
- WFIP or WFSAs
- Daily weather forecasts and spot weather forecasts

- Cumulative fire map showing acreage increase by day
- Total cost summary
- Monitoring data

The park's FMO is responsible for completion of these reports and consolidation of all materials. As soon as a fire is declared out, the report is finalized and delivered to the fire program office where it is entered into a national database known as the Wildland Fire Management Information system (WFMI). The hard copy of the fire report (1202) are also filed in the fire administrative office, and any 'fire package' is stored in the park.

C. WILDLAND FIRE USE

1. Wildland Fire Use Objectives: The Big Bend National Park's fire management program goals and objectives are aligned with the Park's General Management Plan goals and the guidelines of the National Fire Plan.

Wildland fire use is a step toward restoring natural fire regimes in the park. Fuel buildups that are the legacy of the full suppression era dictate that great caution is still required when considering letting natural ignitions burn. Wildland fire use must be soundly based on management objectives—public and firefighter safety, natural and cultural resources benefits, and interagency collaboration—and may include the full range of fire management strategies on a fire's entire perimeter. The objectives of wildland fire use are listed individually in each WFIP and are specific to each wildland fire use for resource benefit response.

The High Desert Grasslands or Grassy Woodlands play a significant role historically in the vegetation of the Chihuahuan Desert and the desert's relationship with Wildland Fire Use. Lightning ignitions do occur and resulting fires are a natural, disturbance regime. In the past 25 years, (Table IV-6) the park has an annual average of 9.6 lightning ignitions and 765 acres burned.

Table IV-6 Lightning Ignitions: 1980-2005

Year	No. fires	Acres burned	Year	No. fires	Acres burned	Year	No. fires	Acres burned
1980	5	3.3	1990	16	214.5	1999	11	29.8
1981	2	680.1	1991	6	1492.1	2000	9	7
1982	4	17	1992	8	2687.1	2001	11	10.5
1983	5	0.9	1993	9	3501.8	2002	19	2.2
1984	3	8.1	1994	13	3876.9	2003	3	0.3
1985	6	439.7	1995	17	86.4	2004	4	0.4
1986	1	6.7	1996	11	15.8	2005*	3	0.3
1987	6	111.5	1997	18	2.7			
1988	9	606.1	1998	6	0.6			
1989	37	5325.5						
							242	19,127

*Data is through June 2005.

Big Bend WFU activities are associated with several interagency efforts at the federal, state and local area. Wildland fire use implementation in the park has been communicated to our partners and they are supportive.

2. Fire Use Parameters: All parameters (time of year, position of ignition within the FMU, BI index, etc) available to Fire Managers will be used to make informed management decisions (Periodic Fire Assessment) for Wildland Fire Use. Fires from natural ignitions will be allowed to burn within given areas (maximum manageable area or mma) and under specific prescriptions (Table IV-7) where there are minimal values at risk. Natural ignitions in these areas are expected to be infrequent and isolated with fire spread contained by natural barriers.

Table IV-7 Prescriptions

	Vegetation Types and Fuel Models					
	Flood Plain (3 & 8)	Scrub Desert (1)	High Desert Grasslands (2)	Shrub Woodland (6)	Grassy Woodlands (2)	Forest (10)
Parameters						
Fire Management Unit (FMU)	1 & 2, RB	1,2 & 3, RB	1, 2 & 3, RB	1, 2 & 3, RB	2 & 3, RB	3, RB
Fine Dead Fuel Moisture (fuel particles <0.25" in size and measured in % of moisture)	Unlimited in non developed areas > 5% in developed areas	Unlimited in non developed areas > 5% in developed areas	> 5%	> 5%	> 5%	> 5%
Mid-Flame Wind Speed (mph)	Unlimited in non developed areas < 8 mph in developed areas	Unlimited in non developed areas < 8 mph in developed areas	0 to 8	0 to 8	0 to 8	0 to 8
Live Fuel Moisture (%)	n/a	n/a	>100	n/a	>100%	>100%
Slope (%)	n/a	n/a	n/a	>25% ONLY in secure locations	>25% ONLY in secure locations	>25% ONLY in secure locations

Legend for Table IV-8

RB = Research burns can be conducted in all FMUs to meet natural or cultural resource objectives.

Fuel Models (derived from Anderson, 1982)

Fine Dead Fuel Moisture (FDFM): This relates to grasses and other fine texture or small particle fuels. The measurement considers temperature, relative humidity, time of day, aspect, slope, shading (from overstory or clouds), and season (winter, spring, summer, fall). Measurements range from 2 to 20%. The higher percentages indicate wetter fuel.

Mid Flame Wind Speed (MFWS): MFWS is the average velocity of wind measured at eye level. This can be read directly with a handheld anemometer or calculated from weather station wind speed measurements (at 20 ft and average over 5 minutes) with the consideration of the sheltering effect from vegetation or topography.

Live Fuel Moisture (LFM): This measure is related to the stage of vegetative growth and moisture content of live vegetation. LFM may range from a high of 300% for fresh, moist new growth foliage to a low of 30% for completely cured and dry old foliage. The 100% live fuel moisture rating is considered mature foliage with new growth complete, comparable to older perennial foliage. Where LFM is not a crucial factor in predicting fire behavior in certain fuel models, it is listed as N/A.

Slope and Secure locations: This relates to the steepness of the topography. A rating of "n/a" means to allow fire spread on all slopes in these vegetation types. At higher elevations and woody vegetation, prescribed and natural ignitions are allowed on slopes > 25% only if the fire spread is a backing fire (backing down hill, against the slope) or the fire spread will likely stop against fire spread barriers (talus slopes, cliffs, and other secure locations).

A number of pre-determining factors would also be weighed (Figure IV-4 and Table IV-8), including national preparedness levels, air quality restrictions, and current local resource availability. If fire spread can be managed with available resources, if ecological values will be enhanced, if cultural values can be protected, and if air quality effects to the park and the surrounding airshed are minimal or manageable, then fire use projects are acceptable.

Decision Flow Chart for Initial Action on Ignitions

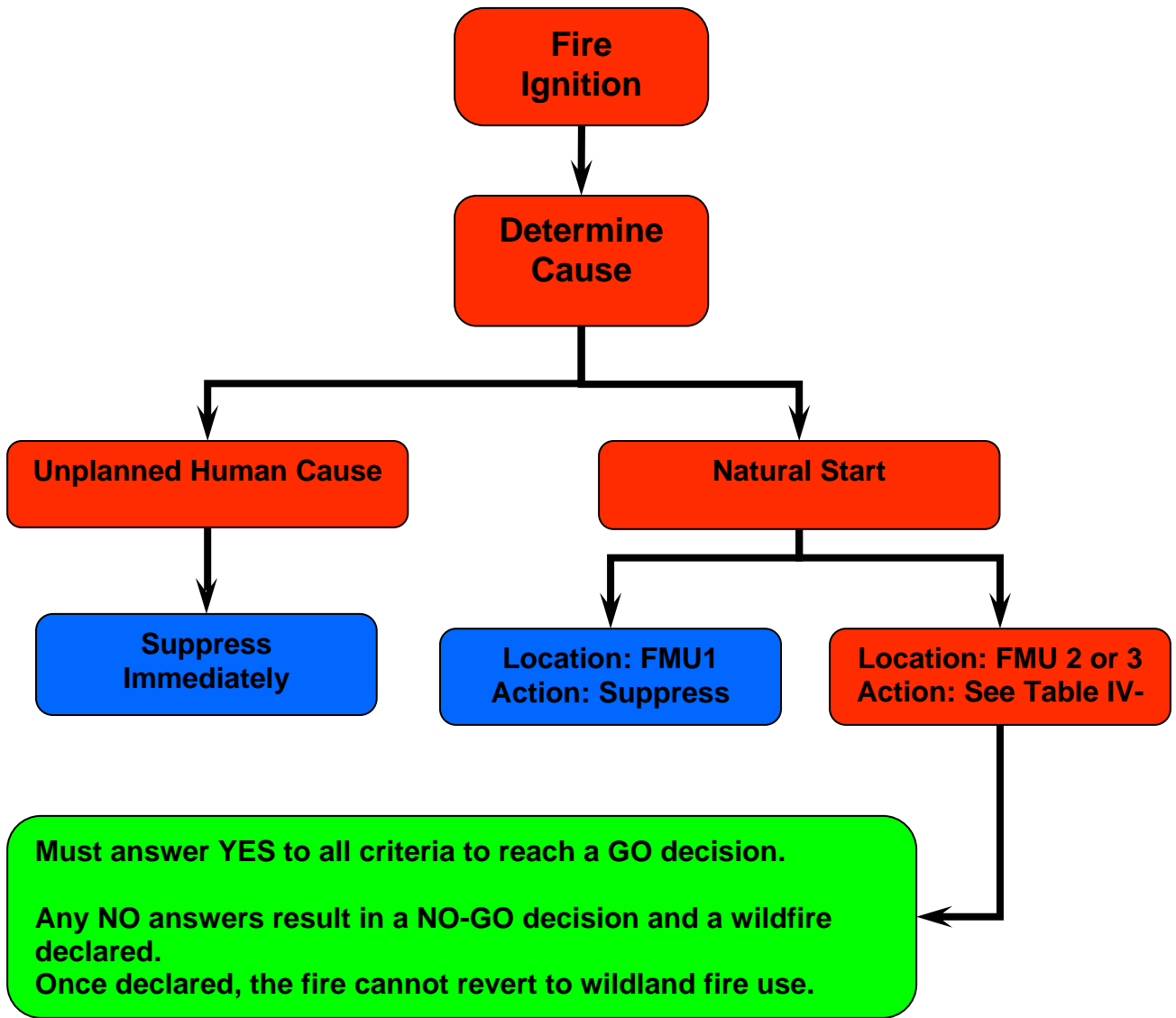


Figure IV-4: Decision Tree for Initial Action on Ignitions

Table IV-8 Wildland Fire Use Decision Criteria

Decision Criteria	Questions
Ignition	<p>Is it a natural source?</p> <p>Is the location within a wildland fire use zone? <i>Or</i>, Can the natural ignition meet research requirements under Research Burns? [Fire use decisions depends on meeting location, values-at-risk, season, and desired outcomes criteria]</p>
Management Objectives	Are resource objectives being met? Are potential effects on natural and cultural resources within the acceptable range of effects and variability?
Size	<p>Is the current and expected size known?</p> <p>Is the potential risk for escape acceptable?</p>
Fuels	Are live fuels moistures within prescription?
other	Are drought indicators acceptable: i.e. 1000-hr TLFM*, Palmer drought index)
Topography	Is the terrain in locations for potential holding actions along the maximum management area accessible and safe for crews to work in?
Resource Availability	Are local, regional or national resources available? Is there a qualified, dedicated individual to manage the fire as an ICT4 or FUM2, depending on stage of management?
Safety of Life and Property	Can the threats to firefighters, staff, visitors, residents, neighbors, associated property and infrastructure be minimized?
Environmental Constraints	Is smoke dispersal and direction acceptable?
Political Constraints	Is managing this fire for wildland fire use compliant with current policy, moratoriums, political constraints, funding and efficiency issues?
Summary	If YES to all above – manage within prescriptions

TLFM* = Time-lag fuel moisture. 1000-hour TLFM is a measure of moisture content of the largest diameter fuels.

In all cases, wildland fire use incidents will be monitored by fire personnel. The fire management strategy will transition from fire use to suppression when a) periodic assessment recommends this, b) the fire threatens to exceed the maximum manageable area, c) or the fire poses a threat to other values.

Such wildland fire use must be confined within the FMU #2 or #3. All Wildland Fire Use fires are to be monitored daily, or more frequently, using the Wildland Fire Implementation Plan (WFIP). The Fire Use Manager must collect and maintain current information on size, location, behavior, smoke dispersal, safety conditions, and fire effects as described in RM-18, Chapter 11.

The Park Superintendent has the authority to decide whether a Wildland Fire Use ignition will be permitted to continue to burn. The Superintendent's decision must be based upon prescription parameters and conditions discussed in RM-18, Chapter 9, and on the recommendations of the Fire Use Manager.

The frequency (daily or less frequent) for completing the Periodic Fire Assessment is established based on the current and expected fire and weather situation. When Big Bend sets a monitoring and assessment frequency, the Fire Managers will develop a "step-up" frequency based on levels of fire activity, external attention and influences, or other critical concerns. Then, as situational concerns escalate, the monitoring and assessment frequency can correspondingly increase. Conversely, as situational demands lessen, monitoring and assessment can "step down" and become less frequent.

**Standards and Rationale for Establishing Assessment Frequency
"step-up" assessment frequency actions.**

Fire Size > 300 acres

Fire Size < 300 acres

Observed Rates of Spread exceed 20 chains per hour

Fire Size doubles

"step-down" assessment frequency actions.

**Fire Size > 300 acres
acres**

Fire Size < 300

Observed Rates of Spread < 20 chains per hour

Same

The valid dates in the WFIP reflect the length of time that the identified assessment frequency will be used. If the assessment frequency is changed, the valid dates must be changed accordingly.

Big Bend has weather monitoring capability and is part of a regional network. The Chisos Basin RAWS is located just southwest of the Chisos Basin Ranger Station in the approximate center of the Park, at 5,400-ft elevation. This station reflects weather conditions affecting the higher elevation level of the Shrub Woodlands vegetation type and the low elevation level of the Grassy Woodland vegetation type. The Panther Junction RAWS is located southwest of the Panther Junction Visitor Center at 3759 ft. elevation. This station reflects weather conditions affecting the higher elevation level of the High Desert Grasslands vegetation type and the low elevation level of the Shrub Woodlands vegetation type. The Chisos Basin fire weather station was established in December, 1978 and this station transition into a RAWS in 1993. The Panther Junction fire weather station was established in September, 1978 and transition into a RAWS in 1993. Although data has been collected since 1978, reliable data begins with 1984.

Big Bend National Park participates in an interagency fire weather program that includes the latest technical tools for obtaining and analyzing fire weather data. This program is outlined in a detailed document named the "Southwest Area Fire Weather Annual Operating Plan, 2004" and it is updated periodically. The Park also participates in a second interagency fire

weather program "Fire Danger and Preparedness" sponsored by the Texas Forest Service. The Big Bend Fire Management program will continue to utilize whatever tools and expertise are made available through the interagency fire weather program.

3. Pre-planned Implementation Procedures: Fire Family+ software seasonal assessment tools will be used to develop weather analysis and pocket cards for reference in wildland fire use implementation.

Pre-Planned Actions:

When a fire is reported, the parks will take the following actions:

- **Locate the fire**
- **Size-up and determine cause**
- **Complete a WFIP Stage I analysis** to determine the *appropriate management response* within two hours of fire confirmation.
- **Report incident to Texas CEQ, El Paso Air Quality District**
- **Choose the *appropriate management response*** based on the previous Stage I analysis (Agency Administrator). In this example, the decision is made to manage the fire for resource benefit because the agency administrator found the potential for complexity, climatology, projected fire behavior, natural and cultural resource effects, and relative risk indicators to be acceptable.
- **Implement the *appropriate management response*** – For fire use projects this may vary from periodic aerial reconnaissance to on-scene fire monitors. If the management complexity of the fire exceeds the capabilities of local resources, the parks will manage the incident through delegation to a Fire Use Manager or Fire Use Incident Management Team (for a delegation of authority example, see Appendix M).
- **Continue to reassess the fire situation** – During a fire use project the park must perform periodic fire assessments. The superintendent must continually validate that the fire is managed appropriately and will assess if there is a need for a more detailed stage II or III WFIP analysis, or conversion to a wildland fire suppression action. The frequency of the periodic fire assessment will be indicated on the signature page of the Periodic First Assessment form attached to the WFIP. Signature frequency can range from daily (high complexity, high risk fires) to weekly (low complexity, low risk fires). If the periodic assessment indicates that the fire can no longer be successfully managed for resource benefit, a Wildland Fire Situation Analysis (WFSA) will be prepared to analyze and document changes in fire

management strategy. The WFSA format is available online at <http://www.fs.fed.us/fire/wfsa/>

• **Manage the fire until declared out** according to monitoring and frequency guidelines indicated in the WFIP. At the minimum, periodic ground or aerial reconnaissance will be used to verify the periodic re-validation of the fire use response. More in-depth monitoring may be necessary to ensure proper incident management if complexity or risk increases. The parks monitor for wind speed, wind direction, smoke plume rise and dispersal, temperature, humidity, fuel moisture, fire size, and fire behavior (rate of spread, direction of spread, intensity).

4. Non-pre-planned Implementation Procedures:

a. Procedures for Periodic Assessments: The most current version of the Wildland Fire Use Implementation Procedures Reference Guide (May 2005) will be the basis for completion of WFIP. This guide requires qualified personnel to complete the WFIP stages. Until declared out, any fire use fire will be periodically assessed (daily or more frequently) and this assessment documented by the Superintendent on the Periodic Fire Assessment form.

Table IV-9: WFIP Completion Timeframes

WFIP Stage	Maximum Completion Timeframe
I	8 hours after confirmed fire detection and Strategic Fire Size-up
II	48 hours after need indicated by Planning Needs Assessment
III	7 days after need indicated by Planning needs Assessment
Periodic Fire Assessment	As part of all stages and on assigned frequency thereafter

b. Requirements for preparation of WFIP plans: A Wildland Fire Implementation Plan (WFIP) will be initiated for all wildland fires. Included in Appendix K, the full WFIP is a three-

stage document, progressively developed for all Wildland fires managed for resource benefits. The Fire Management Officer or other qualified ICT4 will be responsible for completing the Stage 1: Initial Fire Assessment that provides the decision framework for selecting appropriate management response. Operational management decisions are described in the WFIP. Specific WFIP requirements are outlined in the Wildland and Prescribed Fire Management Policy Implementation Procedures Reference Guide hereafter referred to as the Implementation Guide.

The Stage I: Initial Fire Assessment includes the Fire Situation and the Decision Criteria Checklist for the initial "go/no-go" decision. It documents the current and predicted situation, documents all appropriate administrative information, and aids managers by providing them with decision criteria to make the initial decision whether to manage the fire for resource benefits or to take suppression action. In addition to the checklist shown in the Implementation Guide, other unit-specific management criteria may be added if managers feel they contribute to the decision process (Table IV-7). The Stage 1 must be completed by a qualified ICT4 within 8 hours of fire discovery and initial size-up.

5. Potential Plan Implementation Impacts: Based on historic fire occurrence within the Park, most fires managed for resource benefit will require only a Stage I Plan: Initial Fire Assessment, as they involve only a single tree or yucca in very sparse fuels, isolated by natural barriers, and burning out naturally within 24 hours. Approximately 17% of the lightning caused fires may have some potential beyond 24 hours and would require a Stage II Plan, Short-Term Implementation Actions and regular revalidation. Due to comparatively sparse fuels, and low risk of significant spread over a long time period, it is highly unlikely that fires will require a Stage III Plan, Long-Term Assessment and Implementation Actions.

Impacts in general will not be significant beyond the Fire Management Program, which will experience an increased work load. The rare longer duration Wildland fire use incident will create local jobs (feeding assigned resources, transportation services, etc.) and have moderate impacts to park operations (press release, logistical support, mapping and data gathering, etc.).

6. Staff Positions for Implementation: A qualified Fire Use Manager (FUMA) will be required for each Wildland fire use incident. If one is not readily available then one will be resource ordered immediately. It is not possible to manage WFU without a FUMA after Stage 1 is completed. When an ignition occurs the following positions will make up the implementation management team that will be responsible for initiating steps in the decision process necessary to support the appropriate management response, whether it be wildland fire use or suppression.

Superintendent:

- Responsible for making the Go/No Go Decision based on information provided by the FMO/Fire Use Manager
- Ensures requisite compliance and consultation has been done for fire management activities
- Signs the Wildland Fire Implementation Plan (WFIP) and periodic assessment to validate the WFIP decision
- Declares park restrictions and/or closures as needed
- Issues a written delegation of authority in the event a Fire Use Management Team is assigned and assigns an agency representative
- Insures that fire information is managed as described in Big Bend's FMP, Chapter IX

The following training is recommended for this position:

- Fire Management for Agency Administrators
- National Park and Wilderness Fire Management
- Participate in one post-season wildland fire use review or evaluation

Chief Ranger:

- Evaluates fire activity in terms of public and employee safety and makes recommendations to the superintendent for closures or restrictions
- Insures patrols are used to enforce restrictions or closures
- Designs and implements the park evacuation plans at the discretion of the superintendent
- Insures that a comprehensive fire management program at the park is adequately planned for and implemented
- Assists in development of Maximum Manageable Area and management decision points

It is recommended that this position meet the following qualifications and/or conditions:

- Fire Management for Agency Administrators
- National Park and Wilderness Fire Management
- Familiar with park resources.
- Familiar with wilderness laws, policies, and philosophy.

Fire Management Officer:

- Insures implementation of fire management plan and coordinates wildland fire and prescribed fire programs
- Responsible for insuring that the fire program is managed within RM-18 guidelines
- Responsible for analyzing fire weather and fire season severity to support fire use decisions, preparing WFIP stage I and the Relative Risk Rating Chart on all wildland fires
- Establishes the review timeframes for periodic assessment on all declared wildland fire use projects Completes WFIP Stage II, coordinates with state air quality, local wildland agencies, and orders resources as needed, such as monitors, prescribed fire behavior analyst, or a Fire Use Management Team
- Provides input into Maximum Manageable Area and long-term risk assessment in accordance with Stage III
- Serves as the Fire Use Manager for wildland fire use projects
- Orders resources, supplies and equipment and materials to support wildland fire use projects

This position will meet the following qualifications and conditions:

- NWCG qualifications for ICT3 and Fire Use Manager.
 - Knowledge and experience in the fuel types and ecosystems referenced in this plan.
 - Knowledge and experience with wilderness resources.
 - Attend National Park and Wilderness Fire Management.
 - Attend Fire and Ecosystem Management.
 - Participate in one post-season wildland fire use review or evaluation.
 - Be able to perform this assignment for the duration of the event.
- Would be unavailable for fire suppression assignments.

Fire Management Program Assistant:

- Acts as logistics coordinator and comptroller for project
- Track expenditures daily against the fire account, reports expenditures to the FMO and prepare a final
- financial package as an official record of the project that will be reviewed during program audits

Fire Ecologist:

- Monitors and documents fire weather, behavior, and fuel consumption and map location
- Works with the Resource Advisor for coordination of monitoring requirements, methods, and staffing
- Provides feedback to the FMO and or fire use manager in terms of fire use and resource management objectives
- Assists in development of Maximum Manageable Area and management decision points

This position will meet the following qualifications and/or conditions:

- Familiar with park resources.
- Familiar with wilderness laws, policies, and philosophy.
- Attend National Park and Wilderness Fire Management.
- Attend Fire and Ecosystem Management.
- Knowledge of and ability to operate GIS/GPS systems, FARSITE and RERAP fire prediction programs.

Duty Officer:

- Report resource availability
- Update weather activity
- Situation report to Lincoln Zone Dispatch
- Serves as contact point for Initial Attack
- Logistics Coordination

This position will meet the following qualifications and/or conditions:

- Familiar with park resources
- Incident Commander Type 4
- Be able to perform this assignment for the duration of the event. Would be unavailable for fire suppression assignments.
- Knowledge and experience in the fuel types and ecosystems referenced in this plan.

• **Resource Management Specialist(s):**

- Provides input during candidate and ongoing wildland fire use projects regarding sensitive species, special resource concerns
- Assists in development of Maximum Manageable Area and management decision points
- Aids in development and implementation of individual monitoring plan for each WFIP Stage in coordination with the Fire Ecologist
- Responsible for compliance and consultation initiation/documentation

This position will meet the following qualifications and/or conditions:

- Familiar with park resources.
- Familiar with wilderness laws, policies, and philosophy.
- Attend National Park and Wilderness Fire Management.
- Attend Fire and Ecosystem Management.

Resource Advisor(s):

- Provides input during candidate and ongoing wildland fire use projects
- Assist in development of Maximum Manageable Area and management decision points
- Aids in development and implementation of individual monitoring plan for each WFIP Stage in coordination with the Fire Ecologist

This position will meet the following qualifications and/or conditions:

- Familiar with park resources.
- Familiar with wilderness laws, policies, and philosophy.
- Resource advisors that work on any active portion of fireline **must** meet physical fitness requirements for an arduous duty fire qualification card (red card).

7. Public Information Provisions: The FMO, Chief Ranger, and Park Information Officer will meet after the initial designation of a wildland fire in order to determine the most appropriate information and interpretive needs. In order to cover the information and interpretive needs, the Chief of Interpretation and Information Officer will insure that the following actions are taken:

Initial Action:

1. Obtain briefing from FUMA or FMO covering the current situation, size, location, expected duration, resources committed, resource threats, anticipated closures, and plan of action.
2. Inform media of wildland fire activity - size, location, expected duration, resources committed, and any anticipated restrictions or closures.
 - a) Prepare 'draft' press release, reviewed by FMO and approved by the Superintendent, for immediate release discussing the fire(s), objectives of the operation, size(s), location(s), expected duration, resources committed, and any anticipated restrictions or closures.
3. Assign Field Information Officers as required by the operation, or requested by FUMA or FMO.
4. Assign Interpreters, as required, to provide increased visitor information services in the affected district relating to the prescribed fire operation.
5. Provide briefing to cooperating agencies (TxFS, TPW, Brewster County, Alpine) on fire situation.

Key agency, state, and local contacts for public information include:

- Big Bend National Park, Panther Junction Visitor Center Information Desk (432-477-1158), Fire Management Office (432-477-2397/2369), Fire Information Officer (during ongoing Wildland & prescribed fire incidents)
- Lincoln Zone Dispatch Office, Lincoln National Forest (505-437-0778)
- Brewster County Emergency Management Office (432-837-9876)
- Brewster County Sheriff's Office (432-837-5541)
- Texas Forest Service Regional Coordinator (432-336-7290)
- Texas Commission of Environmental Quality, (Air Quality) El Paso District (915-834-4949)
- National Park Service, Intermountain Region Fire Operations , Denver, CO, Information Officer (303-969-2948)
- Other interest groups as appropriate (hiking clubs, neighborhood groups)

8. Wildland Fire Use Project Records:

- a.** Each wildland fire use project will have a permanent record developed which will be maintained in the permanent Fire Management Office files at Park Headquarters. This record will include: 1) the approved Wildland Fire Implementation Plan (Stage I, II, III as applicable) including all amendments and revisions; 2) Wildland Fire Situation Analysis (if required).
- b.** Monitoring reports and summaries of findings, along with a summary of all monitoring activities including a monitoring schedule (level 1 and 2 monitoring) as prescribed in the Big Bend National Park Wildland and Prescribed Fire Monitoring Plan (Appendix F).
- c.** All revalidation and certification documents.
- d.** Funding codes (FIRECODE account information) and all cost accounting documents, including daily and summary spreadsheets.
- e.** Project Maps. All fires greater than 100 acres will be permanently mapped and archived, using GIS whenever possible. A digital shape of the fire perimeter, gathered from field observations and/or mapping with GPS should be standard procedure.
- f.** Include other fire incident information as appropriate, such as photo points and monitoring plot locations.
- g.** Wildland fires are funded through normal accounting procedures using individual project accounts. The Fire Management Program Assistant will establish the fire account and advise the Regional Fire Office so that any resources ordered from outside the park will be charged to the appropriate account. Documentation of all expenditures to the account will be included in the final fire package.

D. PRESCRIBED FIRE

1. Planning and Documentation: Annual application of management ignited prescribed fire is planned for implementation at Big Bend National Park under this Fire Management Plan. The program parameters includes hazard fuel reduction, vegetation maintenance and/or restoration, restoring ecological processes, fire ecology research, historic scene maintenance and debris disposal. In addition, a training program in wildland fire management is to be carried out by utilizing the various components of the overall management burning program. Specific locations and projects are outlined in the Ten-Year Work Plan (Appendix H).

Department of Interior, National Park Service policy and guidelines will be followed in the planning, implementation and review of all prescribed fires conducted on all lands administered by BIBE. The use of any fire ignited by NPS, or NPS designated personnel is considered a prescribed fire, with the exception of debris burning, and is subject to the requirements outlined in RM-18; Chapter 10. Plans shall be peer reviewed by a qualified cooperator. A Burn Boss will be in charge of prescribed fires, if not an NPS, or BIBE employee, then empowered with a Delegation of Authority signed by the Superintendent.

a. Annual Prescribed Fire Activities: The full range of prescribed burn activities may be conducted every year at BIBE. These activities include collaborating with Science and Resources Management for planning and priority setting. Implementation activities include surveys for cultural resources, burn unit preparation (i.e. manual fuel reduction); writing burn plans and conducting prescribed burns.

b. Long-Term Prescribed Fire Strategy: Under predetermined conditions or prescriptions (defined in Table IV-7), resource and fire managers will intentionally ignites fires to achieve resource objectives. Prescribed fire will be used to reduce fuels around buildings, remove hazard fuels in the vicinity of cultural resource sites, maintain habitats of listed species, maintain historic scenes, restore grasslands, or aid in the control of exotics, and where appropriate restore or maintain natural vegetation or reduce excessively high fuel loadings throughout the park.

This annual burning occurs throughout the year, although peak visitation periods are normally avoided. Various ignition devices would be used to start and maintain prescribed fires. Prescribed Burn Plans will be developed for each project according to RM-18 guidelines. The plans shall specify the predetermined ranges of environmental conditions such that fire behavior shall be expected to meet project objectives. Air quality/smoke management guidelines will be followed pursuant to the burning regulations of the State of Texas.

c. Prescribed Burn Organization: Big Bend personnel conduct prescribed fires in the park with and without assistance from Zone cooperators depending on the complexity of the burn and risks to be managed. A designated Burn Boss shall be on scene and identified by participating personnel. All Park and non-Park fire personnel assigned to prescribed fires will meet the requirements of their position as outlined in the Interagency Qualifications and Certification System. The FMO and Burn Boss will be responsible for qualification documentation of personnel assigned to the burns. The Burn Boss will also be the Incident Commander of an escaped fire until relieved. An adequate number of contingency resources shall need to be identified in the Burn Plan and available for the prescribed burn.

d. Weather and Fire Behavior: FTS automated weather stations are in operation in the Park at Panther Junction and Chisos Basin. Records are kept year-round and indices are available year. RAWS stations within the forecast zone include Fort Davis, Midland, The Bowl, Pinery, Barnhart, and Midland.

Specific weather prescription parameters will be developed as a part of each individual Prescribed Burn Plan. The Prescribed Burn Plan weather parameters will be measured on site, before, during and after a prescribed fire to ensure the fire is within prescription (Level 1 and 2 monitoring).

The National Weather Service will distribute morning fire weather forecasts, afternoon updates, fire weather watches, and red flag warnings as specified in their annual operating plan. All dispatch/coordination centers and unit dispatchers will be responsible for distributing fire weather information to

firefighters and incident management personnel at initial attack bases, staging areas, field locations, and committed to initial attack/extended attack incidents. Weather information is available on the internet at:

http://www.srh.noaa.gov/maf/HTML/fire_weather.html

Regular Forecasts: Weather observations from the park stations will be entered into the WIMS computer system. These observations are currently input by Texas Forest Service. A normal forecast can be retrieved about 1400 CST during off season service. During fire season service, one forecast is released at 0930 CDT and another at 1630 CDT. The Dispatch Office is able to make these forecasts available to all fire management personnel via the established communications system.

Special Forecasts: Requests for spot forecasts may be submitted at any time. The internet spot weather forecast process is to be used and is accessed at:

<http://www.srh.noaa.gov/maf/Fire/index.php>

e. Critiques of Prescribed Fire Projects: Each prescribed fire will have a Prescribed Burn Plan. After completion of a prescribed fire, participating personnel will review the fire, elements contained in the Prescribed Burn Plan, complete any monitoring and evaluation requirements, then critique the fire. The objective will be to understand and improve prescribed fire techniques, operations, prescriptions and the fire effects.

f. Reporting and Documentation Requirements: A Prescribed Burn Plan is necessary for conducting any prescribed fire and should be kept on file. Smoke management reporting and documentation is required. All reporting will be accomplished according to RM-18 guidelines. NFPORS accomplishment reporting will be completed.

g. Historic Fuel Treatment: Since 1980, historic fuel treatments at BIBE have been primarily restricted to hazard fuel

reduction burns and mechanical treatments surrounding developed areas. Mechanical treatments for exotic plant removal, hazard trees, and hazard shrub vegetation within the vicinity of campgrounds, historic and administrative structures are conducted annually. Since 1998, broadcast burning has extended beyond areas immediately adjacent to developments and has included research and restoration burns, fuel reduction along access routes and utility corridors, and one phase of activities for the removal of exotic species.

Table IV-10 Prescribed Burn Program 1996-2005.

Name of Burn	Date of Burn	Acres	Vegetation
Boquillas Cyn TH	June-2005	10	exotic
13/14 Junction	May-2005	531	sotol grassland
Tamarisk Piles	Jul-2003	2	exotic
RGV Wetland	Feb-2003	10	riparian
Comanche Draw	Feb-2003	537	desert shrub
Tules	Jun-1999	0.1	riparian
Basin CG	May-1999	9	piñon-juniper
Lone Mtn.	Apr-1999	645	sotol grassland
PJ Block B	Mar-1999	23	sotol grassland
Bone Spring	Oct-1998	0.2	exotic
PJ Block D	Apr-1998	23	sotol grassland
PJ Block A	Apr-1998	40	sotol grassland
CB Block DEG	Sep-1997	70	piñon-juniper
PJ Block EF	Jul-1997	52	sotol grassland
Helispot	May-1997	4	sotol grassland
CB Block B	Jan-1996	10	piñon-juniper
	Total Acres	1966.3 ac	

h. Prescribed Burn Plan Requirements: Every prescribed fire planned and implemented within the boundaries of BIBE will have a Prescribed Burn Plan prepared by a qualified Prescribed Burn Boss, reviewed by the Chief Ranger, by Science and Resource Management Specialists, reviewed by a non-BIBE fire specialist, then approved by the Park Superintendent prior to ignition. The Prescribed Burn Plan will follow the RM-18, Chapter 10 policy and guidelines. The plan peer review process is required in advance of the final approval by the Superintendent, and subsequent prescribed burn.

2. Exceeding Existing Prescribed Burn Plan: If a prescribed fire exceeds the perimeters set forth in the Prescribed Burn Plan, the fire will be considered out of prescription. If the fire can be brought back into prescription that same operational period with existing resources and funding, the prescribed fire can continue until all objectives are met. If the fire cannot be brought back into prescription with existing resources and/or funding, it will be designated as a wildland fire. An Incident Commander will be designated and an appropriate management response will be taken on the newly designated wildland fire. Full control of the escape fire is the appropriate management response. If the fire cannot be controlled and becomes an extended attack wildland fire, a WFSA will be initiated, a suppression strategy will be determined and the WFSA will be approved by the Park Superintendent.

3. Air Quality and Smoke Management: Smoke is a consequence of all fires. Increasing emphasis is being placed on mitigating smoke pollution, specifically fine particulate matter, from both natural and management ignited fires. The impact of smoke pollution from wildfire and management fire is recognized, and visual aspects of air quality are being addressed within the park. The wildland fire program must take into account smoke as a source of pollution, major air circulation patterns and conditions which affect smoke dissipation and procedures for mitigating smoke pollution from wildland and management ignited fires.

a. A deteriorated air quality situation currently exists in the park with visibility the highest resource management concern of the visiting public.

b. Program of Action: Park staff will monitor the air quality conditions prior to igniting any prescribe fires in the park. Air quality is a sensitive resource issue and should take into consideration not only the visitor's but also our neighboring community and employee's health and safety. Every effort will be taken to assure that fire operations, specifically management ignited fires will not add to the degradation of air quality on days when the visibility is already impaired.

Smoke dispersal along park roads is a major safety issue and should be also considered a priority when igniting management fires

Strategies which minimize prescribed fire smoke problems are avoidance, dilution, and reduction of emissions (Prescribed Fire and Fire Effects Working Team 1985). The primary tenet of the avoidance strategy is to burn when prevailing winds will not carry smoke into sensitive areas such as population centers, visitor areas, and roadways. In the vicinity of Big Bend National Park, there are few population concentrations which are likely to be seriously affected by smoke from prescribed burning; but, neighboring communities, areas of high visitation, park residences, and roadways must be considered. Burning should take place when smoke plume trajectories are not predicted to reach these areas or when proper precautions, such as placing flagmen on smoke-covered roadways, can be taken.

Smoke concentrations can be diluted by burning under good dispersion conditions, by burning at slower rates, or by reducing the size of parcels burned at one time. Reduced emissions are achieved through effective firing techniques which include the use of backing fires to increase flaming phase combustion and reduce glowing phase combustion. Proper timing, such as burning when fuels are suitably dry, is also important.

Other considerations help minimize smoke production. A burning program should have clear resource management objectives, such as fuel-load reduction or habitat maintenance.

For example, if management goals are to reduce fine fuel levels, burning should occur when the relative humidity, and thus fine fuel moisture, is low, but when larger fuels are moist. This prevents combustion of larger fuels and significantly reduces the production of particulate matter. In addition, prescribed burning should be the most reasonable method to meet management objectives. Unnecessary burning poses safety risks and contributes to unnecessary smoke pollution. Managers should obtain and use weather forecasts and fire weather information from regional National Weather Service offices in Midland, Texas. Such information assists in prediction of fire behavior and smoke dispersion. Finally, mop-up should begin as soon as possible to reduce smoke production from glowing phase combustion.

I Class I Air Shed: The entire park is within a Class 1 air shed under the Clean Air Act.

II Pre-identified smoke sensitive areas: All developed areas are considered sensitive areas.

III Local and regional smoke management restrictions and procedures:

Pollution from management ignited prescribed fires is regulated to protect the environment. Particulate matter emissions are regulated through an ambient air quality standard of the Clean Air Act of 1967, which covers particles from 0 to 50 μm . Allowable outdoor burning (including prescribed burning for range and forest management) is governed by the Texas Commission of Environmental Quality, revised Outdoor Burning Rule, Title 30 Texas Administrative Code (TAC), Sections 111.201 through 111.221

A number of general requirements exist for allowable outdoor burning, but several are particularly applicable to Big Bend National Park:

1. Notify the Texas Forest Service before carrying out any prescribed or controlled burns that are intended for forest management.

2. Begin or continue burning only when the wind direction and other weather conditions are such that the smoke and other pollutants will not present a hazard to any public road, landing strip, or navigable water (e.g., lake, river, stream, or bay) or have a negative effect on any off-site structure containing "sensitive receptors" (e.g., a residence, business, farm building, or greenhouse).
3. Post someone to flag traffic if at any time the burning causes or may tend to cause smoke to blow onto or across a road or highway.
4. Keep fires downwind of or at least 300 feet away from any neighboring structure that contains sensitive receptors. This requirement may be waived only with the prior written approval of whoever owns or rents the adjacent property *and* either resides or conducts business there.
5. Begin burning no earlier than one hour after sunrise, end it the same day and no later than one hour before sunset, and make sure that a responsible party is present while the burn is active and the fire is progressing. At the end of the burn, extinguish isolated residual fires or smoldering objects if the smoke they produce can be a nuisance or a traffic hazard. Don't start burning unless weather conditions are appropriate for smoke to dissipate (winds of at least 6 miles per hour; no temperature inversions) and for you to be able to control the fire (winds no faster than 23 miles per hour).

Regulatory authorities, and others in the area that may be impacted, must be notified in advance of plans for open field burning. The Fire Management Officer is responsible for ensuring that these requirements are met.

E. NON-FIRE FUELS TREATMENT APPLICATIONS

1. Mechanical Treatment:

a. Annual Activities: Non-fire fuel treatments (mechanical) are routine in Big Bend National Park. These treatments include hazard fuel reduction immediately adjacent to park owned structures and near campgrounds. Also, roadsides and utility corridors in the forested mountains are proposed for treatments to thin and clear hazardous vegetation. Selective thinning around several historic properties has been identified to increase protection of these properties from the negative impacts of wildfire. These activities include collaborating with Facility Management and Science and Resources Management for planning and priority setting. Specific locations and projects are outlined in the Ten-Year Work Plan (Appendix H).

b. Restrictions: Non-fire fuel treatments are primarily completed by use of hand tools, including chainsaws. In the proposed wilderness area, minimum requirement analysis is completed prior to the chainsaw use. Limited use of mechanized equipment (backhoe and bobcat loader) has been made where (campgrounds) this method is appropriate with park management direction. Tractor mowers are used to reduce grass cover in the campgrounds and along roadsides. Chippers have been utilized to reduce some of the material being removed. The residual chips have been re-used in re-vegetation of other disturbed lands within the park. The majority of fuel treatment residue (limbs, brush, etc) is being removed from the treatment site and transported to park lands undergoing re-vegetation treatment. The cover provided by the fuel treatment is providing opportunity for grassland restoration.

c. Monitoring Requirements: The fuels treatment effects are being monitored and the treatment monitoring objectives are discussed in the Wildland and Prescribed Fire Monitoring Plan (Appendix H). Cost accounting and

project reporting/documentation for all non-fire fuels treatments are required. Invasive and exotic species (Tamarisk, Bufflegrass and Giant Reed) are identified for removal in a separate Exotic Plant Plan (in draft). The removal of exotics plants adds to the park-wide reduction of hazardous fuels that place natural and cultural values (cultural sites, upland springs and streams, endangered species) at risk.

d. Mechanical Treatment Critiques: After completion of a mechanical treatment, participating personnel will review the treatment, elements contained in the Plan, complete any monitoring and evaluation requirements, then critique the treatment. The objective will be to improve mechanical treatment techniques, operations, objectives and the mechanical effects.

e. Cost Accounting: All costs will be accounted for and documented (spreadsheet). This cost documentation will become a part of the project record and utilized for cost estimating of future projects.

f. Reporting and Documentation A Mechanical Treatment Plan is necessary for conducting any mechanical treatment and should be kept on file. Accomplishment of treatment objectives reporting and documentation is required. All reporting will be accomplished according to RM-18 guidelines

g. Annual planned project list: This list is contained within the Ten-Year Treatment Plan (Appendix H-1).

F. EMERGENCY REHABILITATION AND RESTORATION

The Department of Interior Office of Wildland Fire Coordination has issued policy to authorize and provide the means for managing emergency stabilization and rehabilitation following wildland fire on lands or threatening lands under the jurisdiction of the Department of the Interior, or lands adjacent thereto (620 DM 3). The three primary components of this policy are listed below.

Emergency Stabilization: To determine the need for and to prescribe and implement emergency treatments to minimize threats to life or property or to stabilize and prevent unacceptable degradation to natural and cultural resources resulting from the effects of a fire.

Rehabilitation: (1) to evaluate actual and potential long-term post-fire impacts to critical cultural and natural resources and identify those areas unlikely to recover naturally from severe wildland fire damage. (2) To develop and implement cost-effective plans to emulate historical or pre-fire ecosystem structure, function, diversity, and dynamics consistent with approved land management plans, or if infeasible, to restore or establish a healthy, stable ecosystem in which native species are well represented. (3) To repair or replace minor facilities damaged by wildland fire.

Fire Suppression Activity Damage Repair: (1) To evaluate and plan fire suppression activity damage repair. (2) To fund and implement projects that meet specific Department of Interior criteria found in section 3.10 of 620 DM3 as well as agency administrator criteria. (3) To complete fire suppression impact rehabilitation with suppression resources as timely as possible.

The Burned Area Emergency Rehabilitation Plan for the park is found in Appendix L.

V ORGANIZATION AND BUDGETARY PARAMETERS

A. FIRE MANAGEMENT ORGANIZATIONAL STRUCTURE

The following positions have direct responsibility for the implementation of the fire management program at Big Bend National Park. The park will maintain at a minimum a Type 3 incident fire organization.

Fire Management Program, Big Bend National Park

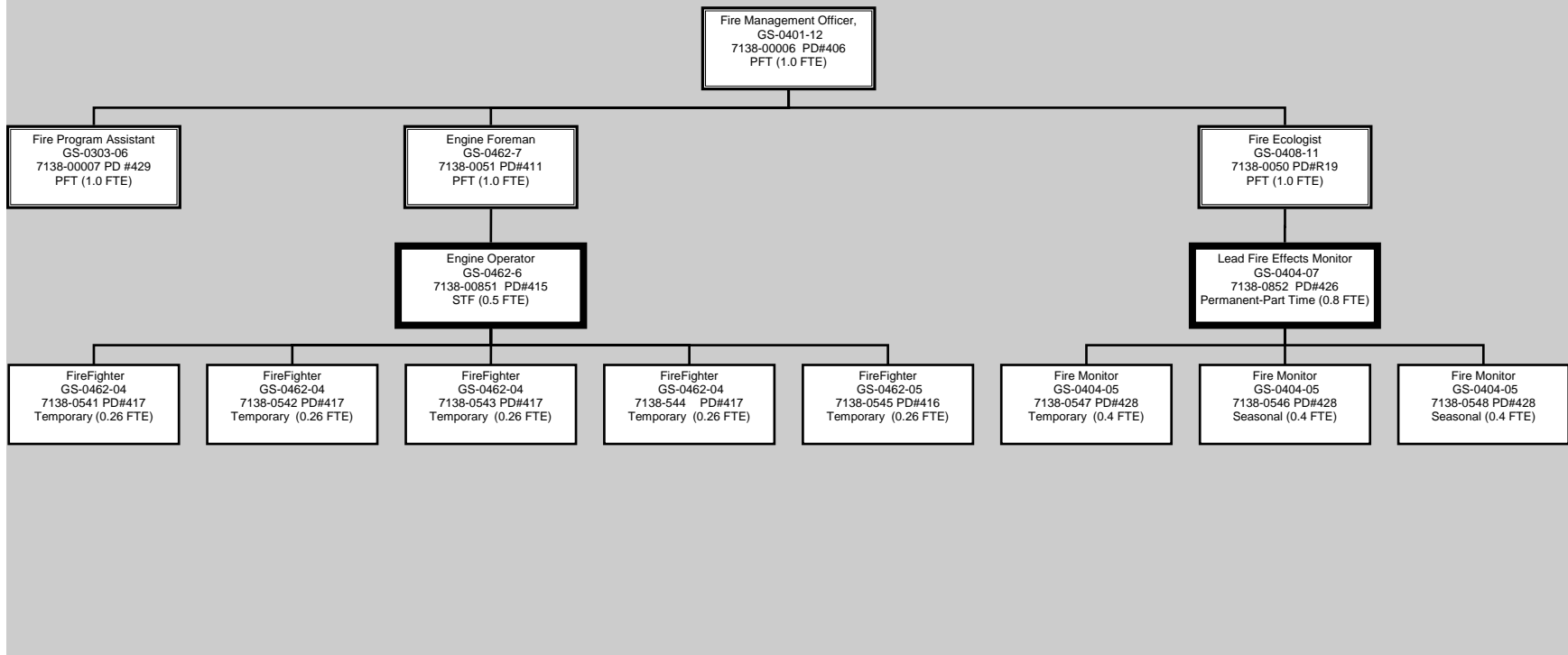


Figure V-1 Organization chart for Fire Management Program, Big Bend National Park as of 2005. PFT = permanent full time, STF = subject to furlough

Responsibilities:

1. Fire Management Officer: The Fire Management Officer reports directly to the Chief Ranger of Big Bend National Park. Minimum fire line qualifications for the Fire Management Officer are found in *Interagency Fire Program Management Qualifications Standards and Guide August 2001*.

The Fire Management Officer is responsible for all wildland fire operations, including the following:

- Directly supervises and coordinates the prevention, preparedness, management/ suppression of fire programs within the Park.
- Develops and updates park fire management plans, including annual appendix updates.
- Monitors fire danger and recommends fire restrictions in concert with neighboring agencies
- Prepares the fire program budget and coordinates/manages all fire funding and accounts.
- Serves as the lead Interagency Wildfire Contact for the Park, maintaining frequent communication with other units of the Southwest Texas Fire Planning Unit as well as state partners.
- Coordinates Park activities with regional fire staff.
- Directly supervises program lead fire staff.
- Approves DI-1202s for all support actions and fires inside the park. Ensures reports are entered into national database..
- Initiates taskbooks for wildland fire positions, certifies completion.

2. Fire Management Program Assistant: The Fire Management Program Assistant supports the Fire Management Program. This position is responsible for:

- Tracking and updating employee training, incident experience, certifications, qualifications and issuance of "red cards."
- Entering data into various fire-related databases.
- Payroll for fire employees.
- Tracking expenditures charged to fire accounts.
- Processing of travel and personnel documents.
- Documents and keeps records of training classes, out-unit assignments and on-site fire management activities.
- Updates list of employee fire qualifications and availability with LNZ fire dispatch or ROSS.
- Maintains and updates fire program budget in park programs.

- Assist with all support duties, maintains files, completes fire correspondence.

3. Engine Module Supervisor: Supervises a seven-person engine module. Serves as the Incident Commander for initial attack, evaluates on-site conditions, makes tactical decisions, and provides input to appropriate response in compliance with the guidelines of this Fire Management Plan. Minimum fire line qualifications for the Engine Module Supervisor is found in *Interagency Fire Program Management Qualifications Standards and Guide August 2001*.

- Oversees procurement and maintenance of equipment, apparatus, and supply compliment for the Fire Management Program
- Manages fire weather data collection, weather instruments, and station maintenance.
- Ensures personnel and equipment readiness and capability for safe initial response.
- Leads crew on hazardous fuel projects.
- Ensures personnel and equipment readiness and capability for safe initial response.
- Implements signing and fire prevention activities.
- Leads park fire crews in daily readiness activities, including fire safety briefings.
- Leads park wide refresher training, 100 and 200 level training, and engine readiness.
- Serves as acting FMO according to skills and abilities.
- Serves as Duty Officer during fire season.

4. Fire Ecologist, Chihuahuan Desert Parks: Supervises the Fire Effects Module and in coordination with the FMO, is responsible for the periodic review and revision of the Park's Fire Management Plan.

- Assess monitoring reports in relation to project and resource goals and objectives.
- Proposes and secures funding for fire ecology research.
- Develops rehabilitation plans required following suppression actions.
- Serves as the Park's Resource Advisor to the Incident Commander or Incident Team.
- Leads development of monitoring types, including presence/density of non-native plants.
- Facilitates development of multi-year burn plans, to include second or third treatments.

5. Fire Effects Module Supervisor: The Fire Effects Monitor will implement monitoring in accordance with the FMH manual. The lead monitor will schedule and prosecute the work load in the reading of the

plant plots. The lead monitor will provide training, both fire and field techniques. In addition the incumbent will support the planning and implementation of fuels treatments.

- Writes and updates fire monitoring appendix to park fire management plan.
- Ensures fire effects monitoring plots are established according to protocols.
- Analyzes data collected from plots, stores data and reports findings to parks on an annual basis.
- Makes assessments of effectiveness of fire in accomplishing vegetation objectives.
- Reviews prescribed fire and fuel project plans for objectives and monitoring plans.
- Serves as acting FMO according to skills and abilities.
- Leads live fuel moisture monitoring program and provides information to interested parties.
- Provides input into ten year treatment plan and monitoring type descriptions.
- Serves as Duty Officer during fire season.

6. Dispatch Supervisor

- Provide communications with the field.
- Receive and document smoke reports. Inform FMO or Duty Officer as soon as possible.
- Receive/document fire situation updates and orders. Refers orders for action/approval.
- Place spot weather forecasts with National Weather Service. Broadcast forecasts.
- Receive and process resource orders from Interagency Dispatch.

7. Chief, Division of Visitor and Resource Protection: The Chief Ranger directly supervises the Fire Management Officer. Directs and coordinates support activities between the FMO and District Rangers.

- Contribute to protection-based fire management program objectives.
- Monitor effectiveness of wildland fire management plan implementation.
- Assist wildland fire program with needs for fire investigation and enforcement.
- Ensure effectiveness of park dispatch operation in meeting fire operation needs.
- Participate on Wildland Fire Analysis Team as needed. Provide input to WFIP and WFSAs.
- Review and implement fire restrictions, trail and area closures, and evacuations.
- Review fire management plan updates and prescribed fire burn plans.
- Ensure coordination and training of field rangers in fire readiness and initial response. Ensure division personnel participate in fire operations.

(i) 8. Chief, Division of Resource Management and Research

- Contribute to resource-based fire management program objectives.
- Support development of multi-year treatment plans and individual project plans.
- Manage and coordinate NEPA/106 compliance, and accomplish compliance as needed.
- Ensure division personnel participate in fire operations to understand fire use and effects.
- Support development of fire effects monitoring types appropriate to park vegetation.
- Support integrated GIS-based risk analysis models such as FARSITE.
- Participate on Wildland Fire Analysis Team as needed. Provide input to WFIP and WFSA.
- Make resource advisors and specialists available to incident/project teams as needed.
- Through park botanist, compile fire effects information for non-native plants and review proposed treatment areas for infestations, and need to re-seed with local native grasses.
- Responsible for compliance and consultation initiation/documentation.

9. Superintendent:

- Ensures safe implementation of wildland fire management program at Big Bend.
- Ensures program supports Service-wide initiatives.
- Approves wildland fire management plan and updates, interagency agreements and operating plans, delegations of authority, prescribed fire plans, and management of wildland fire use incidents, through daily updates of WFIP or WFSA.
- Ensure wildland fire management program is appropriately planned, integrated with other programs, and adequately supported by other park operations.
- Approve wildland fire management updates, interagency agreements and operating plans, delegations of authority, and prescribed fire plans in absence of Superintendent.
- Participate on Wildland Fire Analysis Team as needed. Provide input to WFIP and WFSA.
- Ensure an agency representative is assigned to Type 1 and 2 incident commanders.

10. Regional Director, Intermountain Region: Authority for the approval of the environmental compliance document for this Fire Management Plan rests with the Regional Director of the Intermountain Region.

11. Duty Officer, Big Bend National Park: The Duty Officer for Fire Management at Big Bend National Park serves on a daily basis during fire season. The purpose of the temporary responsibility is continuing Fire Management Program activities, determining appropriate management response upon notice of new wildland fire reports, maintaining

communications between park dispatch, Lincoln Zone and Fire Management Program employees. A brief description of what needs to be done follows.

Big Bend National Park Dispatch: The Duty Officers needs to contact park dispatch on a daily basis, both during fire season and off season. Preferably in the morning and update the following information:

Resource Availability: What resources do you have on hand for the day, location, and estimated response time.

Update on weather: Inform park dispatch if thunderstorms are building, lightning occurring in the area, strong winds, extremely dry air, etc.

Fire Activity: If there are fires occurring in the area or if we are responding to a fire call.

Rx planning: Inform dispatch if we are going to conduct any burning/black-lining plus the location. Identify Burn Boss to dispatch.
Ensure burning notifications will be made.

I.A response: Let dispatch know who and how many resources are responding to an incident, where they are headed, and if a detection flight is needed. Identify the IC to dispatch.

Extended Staffing: You need to determine if extended staffing is necessary. Some reasons for extending include fire activity in the county/zone, unusual weather, the potential for dry lightening, or high winds. Inform park dispatch of any schedule changes.

Lincoln Zone Dispatch: As a duty officer most of your contact will be for resource availability, a resource order contact, or initial attack on Big Bend National Park.

Resource Availability: You need to know what resources you have daily and what resources are available for out of zone assignments,

Resource Order Contact: If the zone has an order, contact the lead of the crew such as an engine module leader or helicopter manager for the order. Provide park dispatch and the Fire Program Assistant with a copy of the resource order. BIBE Park Dispatch may be the only contact with LNZ and the Duty Officer may not be involved, especially with non-fire orders.

I.A Responsibilities: If a fire call comes in; identify the location. If it is on federal lands, roll the appropriate resources to the scene. If it is in our "cooperator's response area," monitor the radio until requested to respond by county units and contact park dispatch.

IC Qualified: Make sure there are qualified personnel on the engine responding to a fire, a Type 4 Incident Commander is recommended. If an engine with a qualified ICT4 is enroute, another engine can respond with an engine operator and crewmember.

Logistical Coordination It will be your job to coordinate the daily activities from project work, pre staging resources, assigning resources to fires/looking for help if needed from the office staff. Other items include contacting dispatch and keeping Chief Ranger and the appropriate District Ranger advised of daily operations.

Back up Resources: If additional resources are needed to help us on a fire or pre-stage at the stations Panther Junction or Chisos Basin, you need to notify dispatch and tell them your request. Follow-up to make sure you know where your resources are located.

Night Calling: As the Duty officer you will be responsible for taking calls throughout the evening after business hours. Keep park dispatch informed on your location and the best method to reach you. Provide your cell phone and phone numbers to park dispatch.

Contact for I.A: You will be the contact for IA activities. This means if you are first out to a fire response, then this could affect the response to a second incident. In this situation, you need to make a decision to hold at headquarters and coordinate activities or delegate duty officer responsibilities to another appropriate staff member (ICT4 qualified).

REMEMBER DO NOT PREFORM DUAL ROLES OF RESPONSIBILITES. IF YOU START TO GET OVER YOUR HEAD DELEGATE DUTIES TO OTHERS OR CALL FOR HELP.

B. FUNDING

In FY05, the base (excluding fuel treatments and construction) fire program budget for Big Bend National Park was \$448,060; approximately the same funding level for the past several years. Currently, the fire budget is planned and dispersed via the Department Level FirePro program.

A FirePro workload (base) analysis is completed each spring by NPS-NIFC. The FirePro budget proposal is prepared by the FMO, approved by the Park Superintendent and submitted to the Intermountain Region in August. Area parks (AMIS, FODA, PAAL, and RIGR) fire management program needs are considered and included in the budget proposal. Transition to a new interagency Fire Program Analysis (FPA) system will take place over the next three years.

C. FIRE MANAGEMENT PROGRAM AT BIG BEND NATIONAL PARK

The Fire Management Program is a part of the Visitor and Resource Protection Division in the organization of staffing and programs at BIBE. The Fire Management Program staff work very closely with staff from the other 4 Divisions (Administrative Services, Facility Management, Science and Resource Management, and Visitor Services) and the park's Management Team.

D. PERIODIC ASSESSMENT AND CERTIFICATION

The Park Superintendent is responsible to periodically assess and certify by signature that continued management of wildland fire use actions is acceptable. The Park Superintendent under certain conditions may delegate this responsibility to another organizational level.

E. INTERAGENCY COORDINATION FOR FMP IMPLEMENTATION

Big Bend National Park is part of the Southwest Texas Fire Planning Unit. The Southwest Texas Fire Planning Unit is chartered to work cooperatively to implement Fire Program Analysis to achieve fire management objectives in a cost effective manner on an interagency landscape scale.

Only NPS units comprise the federal lands in the Southwest Texas Fire Planning Unit (FPU). One Fire Management Officer from Big Bend National Park manages or guides the wildland fire programs for 5 NPS units; 4 are within the FPU, and the FMO strives for "seamless management" across agency boundaries.

This planning unit includes approximately 12.5 million acres. Specific partners are:

- Four National Park Service Areas comprising 857,000 acres.
 - Big Bend National Park 801,163 ac
 - Fort Davis National Historic Site 474 ac
 - Amistad National Recreation Area 58,500 ac
 - Rio Grande Wild & Scenic River (no land ownership)
- Texas Parks and Wildlife Department comprising 526,120 acres.
 - 3 Wildlife Management Areas (145,247 acres)
 - 14 Park Units (380,873 acres)
- The Nature Conservancy (TNC) of Texas manages five preserves containing 61,000 acres.
- Texas Forest Service Fire Coordination Regions (Ft. Stockton and San Angelo). Approximately 10.5 million acres of private lands are protected within the Fire Planning Unit.

Specific responsibilities for the Fire Planning Unit are defined in the charter. The Fire Planning Unit will meet at least twice annually to review the charter, resolve interagency issues, and formulate budget requests. Fire management resources are allocated on an interagency basis within the Fire Planning Unit. Fire management needs within the Fire Planning Unit are evaluated using standardized protocols of the Fire Program Analysis and funding priorities are negotiated within the Fire Planning Unit.

F. INTERAGENCY CONTACTS

- Brewster County Sheriff's Office
- Texas Forest Service
- Texas Parks and Wildlife
- Lincoln Zone Coordination Center
- Pecos Valley Dispatch
- Southwest Area Coordination Center
- Texas Interagency Coordination Center
- Maderas del Carmen Protected Area
- Canon de Santa Elena Protected Area
- The Nature Conservancy of Texas

G. FIRE RELATED AGREEMENTS

The charter for the Southwest Texas Fire Planning Unit for Fire Program Analysis will be completed in October, 2005. Other interagency and mutual aid agreements pre-date the establishment of the Fire Planning

Unit. These agreements are revised annually or at other self-defined intervals.

There is a five-party cooperative fire protection agreement for the State of Texas between the (1) US Fish and Wildlife Service, Region 2 (2) National Park Service, Intermountain Region, (3) National Forests and Grasslands in Texas; and (4) State of Texas, Texas Forest Service; (5) The Nature Conservancy, Texas Chapter.

Big Bend National Park works within the Lincoln Zone Interagency Fire Operations Plan and has access to a variety of fire management resources including the Federal Interagency Communication Center, (dispatch), water tenders, helicopters, and additional engines.

An Inter-park Agreement between Big Bend National Park and Amistad National Recreation Area, Fort Davis National Historic Site, and Palo Alto Battlefield National Historic Site is in place. This agreement provides the support of full-time Fire Management staff to NPS units without this staff.

The Wildfire Protection Agreement between the Department of the Interior and the Department of Agriculture of the United States of America and the Secretariat of Environment and Natural Resources and the National Forestry Commission of the United Mexican States for the Common Border affects the park. This agreement allows fire resources to cross the international border and cooperate on Wildland fire related programs.

Emergency Equipment Rental Agreements are honored on an interagency basis with the BLM, NPS, USFS, BIA, and State of New Mexico Department of Forestry in the Lincoln Zone. Master lists of these resources are kept at the Lincoln Zone Coordination Center, Alamogordo, NM.

VI MONITORING AND EVALUATION

A. MONITORING PROGRAM

All NPS units that implement wildland fire use and prescribed fire activities must develop short- and long-term monitoring programs to assess accomplishments and to determine the effects of management activities on cultural and natural resources in the parks. While the fire management program is based on a broad array of scientific research that clearly illustrates the important role of fire in the parks' ecosystems, monitoring is essential to provide information about the effects of management activities.

Information from other monitoring efforts will be used to inform the fire management program where pertinent. For example, results from the parks' Inventory and Monitoring Program may be useful to assess the changes occurring in areas of the park affected by wildland fires and areas where fire has been excluded for long periods.

Routine Monitoring

The majority of routine fire related monitoring is accomplished using information provided through the Southwest Coordination Center website. Fire weather is collected by the fire weather stations (417401 – Panther Junction and 417403 - Chisos) hourly. From these observations the National Fire Danger Rating System (NFDRS) indices are generated, providing fire management with fire weather risk factors used in daily planning. Information on air quality, fuel moisture, drought severity and general weather conditions are available on the Southwest Coordination Center Website. (<http://gacc.nifc.gov/swcc/>). This site also provides vital links to the National Weather Service – Midland Office, as well as other federal and state partners.

Live fuel moisture samples are collected, during the fire season, by the park's Fire Effects Module. These fuel samples are processed and provide actual fuel moisture information which is used in planning of wildland and prescribed fires.

Compliance Monitoring

Compliance monitoring in the park focuses on the endangered species. Annual censuses are conducted by park staff. This information will be shared with Fire Management in order to determine status of the species for management of wildland and prescribed fire projects in the park.

Cultural Resources Monitoring

The National Park Service recognizes that the effects of fire and the thresholds for unacceptable damage to some types of cultural resources (e.g., archaeological resources) are not well understood. An ongoing effort to obtain baseline information and develop this understanding would make it possible to refine sound risk management for fire planning. Monitoring the effects of fire in field situations would be an important component of this work. However, until systematic laboratory experiments can be conducted, field-based fire effects monitoring would be limited to empirical observations. For resources such as cultural landscapes, systematic fire effects research and monitoring would focus on indicators or criteria for landscape restoration and maintenance. Outlined below is the minimum level of effort for monitoring the effects of fire on cultural resources at Big Bend National Park. This monitoring would provide feedback on the effectiveness of current resource protection measures, such as site avoidance and pre-burn fuel load reduction. It would be designed to document pre- and post-burn resource conditions that are readily observable, such as preservation of flammable historic fabric, visually identifiable changes in surface artifacts and surface conditions, and changes in landscape conditions in historic districts and cultural landscapes.

As systematic processes for evaluating fire effects evolve, monitoring would be revised to support field evaluation. In the interim, cultural resource specialists (usually archaeologists from the Sul Ross University Center for Big Bend Studies) would identify any necessary pre-burn mitigation for prescribed fires, resource protection measures, and the most appropriate monitoring strategy for planned and unplanned burns. In general, these would consist of the following:

Pre-burn

Known cultural resources will be relocated and current conditions assessed using standard operating procedures. This will include documentation of current fuel loads, likely duration and intensity of a fire, threats to features and artifacts, and potential for subsurface impacts through burning roots and stumps. These data will be assessed to determine: (1) which protection measures should be implemented (if any); (2) the potential for fire effects studies; and (3) additional monitoring needs.

During Burn

For all fires, a Resource Advisor or Technical Specialist would provide recommendations to park managers. Although this would be primarily for resource protection, it would also provide documentation of fire behavior and immediately observable effects of fire in and adjacent to cultural resources. If suppression or holding actions were to be taken, the Resource Advisor would monitor as needed to advise on site-specific actions.

Post-burn

An archaeologist will revisit known cultural resources in burn areas to document any changes in condition and assess post-burn protection needs. Fire effects on cultural resources will be documented and subsequently added to the park's database on the effects of fire and fire management activities on cultural resources. Burn prescriptions and techniques used to protect cultural resources will also be refined.

B. MONITORING PROTOCOLS

Monitoring of fires, both wildland and prescribed, involves the systematic collection and recording of data on fuels, topography, weather, air quality, and fire behavior. Monitoring at Big Bend National Park generally follows the protocols outlined in the *National Park Service Fire Monitoring Handbook*. A fire-monitoring plan is a required element in National Park Service fire management plans. The *Big Bend Wildland and Prescribed Fire Monitoring Plan* found in (Appendix F) provides detailed descriptions and additional protocols for wildland and prescribed fires. The fuels and ecology group within the Fire Management Program will complete this monitoring with assistance provided by other park staff as needed.

Short- and long-term vegetation monitoring objectives applicable to a specific burn area would be stated in the prescribed fire plan. At a minimum, monitoring would comply with the protocol identified in the *National Park Service Fire Monitoring Handbook*. Data collected from short-term monitoring would be attached to the fire report along with any narrative completed by the prescribed fire monitors.

Monitoring includes pre, during, and postfire documentation, and includes documentation of fire location, weather characteristics, fire behavior, smoke dispersal, and the effects of fire on vegetation and fuels. Agency guidelines

direct that all prescribed fires be monitored. The goals of the fire monitoring program are to:

- Verify that prescribed fire program objectives and goals are being met through documentation and analysis of fire effects data and using the data to determine if changes in burn prescriptions are needed.
- To perpetuate a working relationship between fire management and resource management in the developing of fire monitoring goals.
- Increase knowledge of fire behavior and effects on the park's ecosystems.

- Adhere to standardized data collection techniques for the FMH plots.
- Document fire behavior and weather data for all prescribed fires and wildland fires and keep all data organized and accessible.
- Identify areas in which research/monitoring should be initiated.
- Provide historic and administrative data for fires within the park.

Monitoring plots are in place or planned for all six vegetation categories to establish baseline information on species, vegetation structure, cover and height. These plots augment research begun in the late 1970s and early 1980s to develop databases that indicate fire effects over the long-term.

C. WILDLAND AND PRESCRIBED FIRE MONITORING PLAN:

This plan may be found in Appendix F

VII FIRE RESEARCH

A. CURRENT OR PAST FIRE RESEARCH

Research priorities are identified by the Fire Management Program working in close cooperation with the Division of Science and Resources Management. In addition, Big Bend National Park maintains communication with the NPS Intermountain Region as well as researchers at New Mexico State University, Texas Tech University and Sul Ross State University. The current prescribed fire program is based on research carried out in Big Bend National Park and in areas surrounding West Texas over the past few decades. The fire program encourages and seeks out research opportunities relating to fire that will aid the park in making better informed resource management decisions.

Studies on file include:

Dick-Peddie, W.A. and M.S. Alberico. 1977. Fire ecology study of the Chisos Mountains, phase I. CDRI contribution No. 35. BIBE files.

Dunham, A.E. 1996. Long-term ecological monitoring of the U.S.- Mexico borderlands in the Big Bend national Park, TX. BIBE files.

Meents, J.K and Moir, W.H. 1981. Fire Ecology study of the Chisos Mountains, phase II. CDRI contribution No. 17. BIBE files.

W.H. 1982. Fire ecology of desert grasslands in Big Bend National Park. CRDI contribution No. 120. BIBE files.

Muldavin, E., Wondzell, S., and J.A. Ludwig. 2001. Forty years of vegetation change in desert grasslands of Big Bend National Park. BIBE files.

Wondzell, S.M. and J.A. Ludwig. 1983. Plant succession as influenced by soil-geomorphic processes of semi-arid piedmonts of the U.S.- Mexico border. Final Report. BIBE files.

Warnock, B.H. 1970a. Charts, measurement data and examination on selected A& M circular plots. BIBE files.

Warnock, B.H. 1970b. Summary of belt transect data at Big Bend National Park. BIBE files.

Whitson, Paul D. 1965. Phytocoenology of Boot Canyon Woodland, Chisos Mountains, Big Bend National Park, Texas: Permanent Plot Supplement BIBE files.

Whitson, Paul D. 1989. Documentation and analysis of Boot Canyon permanent plots initiated in 1964. BIBE files.

B. FIRE RESEARCH NEEDED

The fire ecology program at Big Bend National Park will tailor the fire effects monitoring program to provide pertinent information for adaptive fire management. Research burns, by definition, will have a research component, which will include replicated treatments (a minimum of 3 treatment replications) that serve as either "controls" (untreated plots) and plots that receive the experimental treatment of prescribed fire, wildland fire use or mechanical thinning, herbicide application or some combination of treatments (i.e. burning + herbicide). Monitoring will also be conducted on fuels projects that are not designated as research to provide feedback as to whether or not natural, cultural or fire management objectives are being met and provide additional information to adaptively manage both wildland fire use and prescribed fire. First entry fuels treatment(s) into a monitoring type, will be considered research treatment having replicated treatment plots and replicated control plots.

A reasonable attempt will be made to address each of the following:

1. Effects of fire on plant community composition.
2. Effects of fire on rare or sensitive plant and animal species.
3. Soil movement, (NOTE: changes in plant composition can be used as a surrogate for soil sterilization (denuded surface) and soil movement =erosion) in response to fire.
4. Effects of fire on fuel loading, ladder fuels, and fuel size class distribution.
5. Forest stand age and size class structure. A Fire Effects Monitoring Plan for the Chihuahuan Desert National Park Units (AMIS, BIBE, CAVE, GUMO) will be drafted that will detail monitoring objectives and methods used for research and monitoring to provide scientifically credible data.

Legacy data collected in the past fifty years (e.g. Warnock 1970a, b; Whitson 1965, 1989; Dick-Peddie and Alberico 1977; Meents and Moir 1981, 1982; Wondzell and Ludwig 1983; Dunham 1996; Muldavin, et al., 2001) will be used to evaluate ecological trajectories and responses to fire. Whenever possible, existing plots from these studies will be re-measured and the resulting data added to the fire ecology database for

the park. Many of these data sets need to be organized, collated, and entered into modern electronic databases to be useful. In addition, many legacy plots will need to be re-located (found) based upon location descriptions in the initial reports. We will accomplish these tasks in advance of the implementation of Research Burns.

These research and monitoring goals will need to be funded by creative combination of resources, including NPS Resource Management funding, FIREPRO, CESU, and other government and NGO sources. Securing funding for adaptive management research is critical to the implementation of the Fire Management Plan.

VIII PUBLIC SAFETY

Managing a fire management program is one of the highest risk operations that a land management agency accomplishes. The first priority consideration in any fire management action is firefighter and public safety.

Safety related issues in fire management are those of endangering humans to high rates of spread and high fire intensities that can occur in a normal fire season. Several programs concentrate on mitigating public and firefighter safety; fire prevention (fire hazard awareness and preparedness), prescribed fire (treatment of high fire risk areas with fire, thus increasing firefighter and public safety), fuel hazard reduction (using mechanical treatments for reduce hazardous fuels), etc. High-risk areas where the public or wildland firefighters are at risk are included in the planning for reducing the hazards.

A. PUBLIC SAFETY ISSUES AND CONCERNS

Safety of visitors, employees, and firefighters takes priority over all fire operations. All key fire personnel are issued the National Wildfire Coordinating Group *Fireline Handbook 410-1*. Consistent and accurate monitoring and evaluation of fire behavior is the basis for the contingency plans, contacts, and briefings that ensure public and personnel safety.

Over the years, visitors and employees generally have come to accept the park fire program. Actions taken to ensure safety have helped to gain this acceptance. Interpretation is vital to the public awareness and understanding of fire and its effects in the park. The fact that most neighboring ranchers and landowners use fire themselves serves to facilitate local acceptance of the park's fire management program.

Public safety is affected by the location of heavy visitor use areas and by human factors. The concentration of human use in Big Bend National Park is in areas where hazardous fuels exist, such as the Chisos Basin, employee residential areas, campgrounds, and visitor centers. There is only one roadway into the Chisos Basin. A fire starting near Route 14 could trap people in the Basin Developed Area by moving up Green Gulch and into the Basin. Some of the park's trails are in canyon bottoms which could be dangerous under certain conditions. A number of backcountry dirt roads receive considerable visitor use. These roads may become

dangerous when fire is close at hand and fire suppression activities are being conducted in the area. The tendency for untrained personnel to become involved with suppression efforts must be recognized. Also, visitors could ignore warnings, or they may be unaware of the risk involved in fire, and tend to wander through burned areas. Sometimes even employees may not respect fire as a potentially dangerous event, particularly in low-intensity fires in fine fuels. All fire personnel must be intimately familiar with the "10 Standard Fire Orders" and the "18 Watch Out Situations."

All fires are routinely monitored and evaluated for safety as conditions change. If necessary, an area may be closed because of hazardous conditions. The Superintendent authorizes, and the Chief Ranger enforces, closures. All Divisions are expected to inform visitors and employees of potential dangers, closures, and regulations in the course of daily contact. On all management fires, the Prescribed Burn Boss is responsible for ensuring that closures and informational signs are properly posted.

The following is a list of public safety issues and concerns that are important to the BIBE:

- Visitor Safety during Fire Management activities.
- Highway traffic adjacent to Fire Management activities.
- Protection of the Wildland Urban Interface within the park.
- Safety for fire personnel and other park staff.

B. PUBLIC SAFETY MITIGATION MEASURES

The following public safety measures will be taken:

- Public safety concerns will be specifically address in each Wildland Fire Situation Analysis (WFSA), and Prescribed Fire Plan.
- Public safety messages should be developed as required and incorporated into the process of fire information dissemination.
- Trails and unimproved roads in the vicinity of wildland fires, and prescribed fires will be closed if potentially hazardous conditions are present to keep spectators at a safe distance.
- Traffic control measures, including smoke warning signs, flashing signal lights, traffic cones, and either fire or law enforcement personnel should be situated on roads where smoke intrusion incidents are anticipated to occur.
- Notification of local communities and adjacent landowners.

IX PUBLIC INFORMATION AND EDUCATION

A. PUBLIC INFORMATION CAPABILITY

The public's right to know and their need to receive accurate information must be recognized. The key person for general information dispersal is the park's Public Information Officer (PIO), who generates press and public information releases from information supplied by the Incident Commander, Prescribed Fire Boss, or Fire Management Officer. The timely flow of information from the FMO to the PIO is essential. The Superintendent's office assures prompt distribution of pertinent fire information to both concession and in holder operations.

The general staff, with Interpretation taking the lead, is responsible for the dissemination of accurate fire information to the visiting public. This includes interpretation of the role of natural fire in Big Bend's ecosystem. In conjunction with the FMO and the Science and Resources Management Division, the Division of Interpretation develops opportunities to explain NPS wildland fire policy to the public. Particular attention is given to interpretation during actively burning fires, including management ignited prescribed fires. Park interpreters also inform the public of wildland fire policy and fire status through personal and non-personal services. Interpretive and fire status messages are for different purposes. They should be separate and distinct.

Keeping service personnel aware of fire management activities is essential to the effective dissemination of information to the general public. The entire park staff should be familiar with the Fire Management Plan, the park's role in wildfire suppression, and the employees' role in fire management. This is accomplished through an on-going education program which includes training, general employee meetings and active participation by park staff in Big Bend's wildland fire program.

All fire related activity will be reported immediately on Inside NPS, the official NPS website for agency personnel on the following website:

<http://data2.itc.nps.gov/fire/admin/index/cfm>

The report should cover mechanical/prescribed burns, WFUs, as well as Wildland fire, and be updated until the event ends. At the end of the event, an entry will be made to close out that activity. All Fire Management and Interpretation personnel should be able to make this activity report.

Other federal agencies, as well as state and local agencies and park neighbors, have a vested interest in the park's fire activities. It is the responsibility of the Chief of Interpretation and Visitor Services to assure an open line of communication with all affected groups. During active fires, communications with other fire agencies and dissemination of information is the responsibility of the Information Officer working through the Incident Commander.

B. STEP-UP ACTIVITIES

Step-up public information activities in response to escalating fire danger or a fire activity includes fire danger signing and reporting this information in the park's daily report (both hard copy and radio broadcast). These methods inform Visitor Center staff and the public during contacts. All backcountry permits will have fire danger warnings attached. Backcountry users will be informed verbally at all visitor centers. Advisory notices will be posted at all visitor centers and other prominent locations. Park neighbors and cooperators will be notified of the fire danger. The Superintendent may issue a public closure as recommended by Fire Management, and this information will be communicated in similar fashion as fire danger.

An integral part of public education is the dispersion of current fire danger information through signs illustrating current fire danger, press releases, and other public announcements. It is important that the residents are made aware of current fire danger levels, and if signs are utilized they should be updated on a regular basis. Signing during prescribed fires is a useful safety tool as well as an aid in educating the public on fire. Other programs that can be incorporated into the BIBE that relate to Public Information and Education are:

- Incorporate the principles of fire's role in the ecosystems surrounding BIBE and the importance of fire as a resource management tool into any interpretive programs, exhibits, videos, interpretive trails through the Park, brochures, civic group presentations, school presentations, etc.
- Educate Park personnel on the nature, value and objectives of the fire program.
- Forward all fire-related press releases to the Park Superintendent and keep all NPS personnel informed.
- Develop and/or assist other wildland fire protection agencies with public information programs that promote the benefits of "Firewise" community planning, defensible space, mechanical fuel reduction, etc.

- Establish rapport with local press and media representatives and accommodate all interview requests that will benefit BIBE by promoting the fire program.

X PROTECTION OF SENSITIVE RESOURCES

Resource managers will continue reasonable efforts to avoid, minimize, and mitigate negative effects of the fire program. These include using best management practices under all alternatives to reduce impacts to human, cultural, and natural resources. Further, staff-developed prescriptions, desired fuel loads, and designation of FMUs, are developed to minimize and mitigate negative effects under the fire program. Despite these efforts there may be need for short-term or long-term rehabilitation following fire. Staff will consult with specialists (archeologists, hydrologists, plant ecologists, wildlife biologists) to determine the treatments needed and then write, implement and monitor these plans. Common rehabilitation for environmental resources actions include: flush cutting stumps, replanting trees, removing trash, brushing in fire lines, installing erosion control devices, felling hazardous trees, and carry out monitoring for short and long-term effects on vegetation and affected species. Below are measures specific to impact topics.

A. ARCHEOLOGICAL/CULTURAL/HISTORIC RESOURCES

Big Bend National Park contains extensive cultural resources which span the past 10,000 years. Thousands of prehistoric and historic archeological sites, ruins, and structures are found in the park. Many are poorly documented. It is essential that fire management activities do not disturb or destroy the cultural resources of the park. Less than 3% of the park has been surveyed for cultural resources and fire suppression has potential to negatively affect unidentified significant archeological sites. Suppression activities, particularly ground-disturbing methods, can damage significant archeological resources.

The historic districts, sites, and properties on the National Register of Historic Places, along with State Archeological Landmarks and other significant cultural resources, are classified as Historic Zones in the park's Statement for Management. For fire management purposes, the areas are to be protected and managed as suppression zones. The specific site locations of these resources are housed in the Division of Science and Resources Management.

The park's fire management program will not attempt to replicate prehistoric or historic fire use. This decision is based on the lack of reliable evidence that fire was used by indigenous people before the 20th century. While fire would have been used in the operations of farms and ranches during the historic period, maintaining the historic scene is not

considered to be an essential part of the park's mission. The historical scene that immediately surrounds buildings will be maintained as prescribed by the Historic Resources Management Plan and the Resources Management Plan.

Highest priority for protection and preservation of cultural resources must be given to National Register properties, State Archeological Landmarks, proposed National Register properties, and properties identified as having potential for National Register listing. Location and construction of fire lines, helispots, fire camps, and mop-up operations should be monitored by professional archeologists. All fire control decisions will be made with input from a professional archeologist. Additionally, archeologist(s) will be involved in planning for management-ignited fire and during wildland fire suppression strategy sessions.

Archeological and historical sites which have not yet been evaluated may be generally prioritized from critical to non-critical. The following list serves as a **general** guideline for use by archeologists familiar with local park resources:

1. Archeological/Cultural Sites:

- Rock Art Site
- Special Use Site
- Calendric Site (astronomical alignment of stone, sight line, etc.)
- Pinnacle or Ridge Top "Vision Quest" Site ("sweat lodge" structure, non-habitation stone enclosure)
- Sheltered Habitation Site
- Boulder Shelter, Overhanging Cliff, Rock shelter, Cave
- Constructed Shelter (stone enclosure, pit house)
- Unsheltered Habitation Site
- Midden, and Midden Circle (ring midden, sotol pit, mesal pit, or agave pit having evidence of intensive, repeated or long duration occupation)
- Hearthfield (having repeated or long duration occupation)
- Open Campsite (with single or multiple hearths, of short duration occupation)
- Burial or Cemetery
- Lithic Procurement or Processing Site
- Casual Surface Procurement (non-extractive gathering)
- Lithic Quarry (mineral extraction)
- Lithic Workshop and Lithic Scatter

2. Historic Sites

- Historic Commercial or Habitation Site (pre-1935 stone, adobe, and dugout structural remains or evidence)
- Historic Park Period Site (post-1935 park development buildings, camping features, CCC period structures and features)
- Non-habitation Ranching (corral, dipping vat, stock tank, etc.)
- Non-habitation Mining (prospect, shaft, audit, spoil pile, mineral processing, structures and features)
- Non-habitation Farming (irrigated farm land, diversion and distribution ditches, control gates, planed or terraced land, etc.)
- Candelilla Wax Camp (fire box, processed waste candelilla, etc.)

Actions to prevent or mitigate negative impacts:

- Locate and identify sites vulnerable to fire effects prior to prescribed burns or mechanical thinning. Use an archeologist that meets the Secretary of the Interior's standards.
- Follow protection measures for known cultural resource sites prior to prescribed burns, especially those vulnerable to fire and situated in or near the project area.
- Carry out post-fire surveys of natural ignitions whenever resources permit.
- Protect and report new sites found during and after burns. Identify known cultural resources park-wide to assist management of fire operations in future.
- Suppression operations are generally considered emergencies exempt from Sec. 106 requirements. Avoid ground disturbance during fire activities by identifying locations of potential natural firebreaks, spike campsites, and staging areas in previously surveyed areas. Do not construct fire control lines through cultural resource sites. Employ "Minimum Impact Suppression Tactics" whenever possible. Ensure an archeologist or similarly qualified resources person is consulted during fire activities.
- Reduce fuels with thinning, buffers and fuel breaks.
- Locate vehicular routes away from cultural resource sites.

- Avoid using fire retardant near cultural resource sites.
- Work with tribes and work crews to protect ethnographic resources.
- Identify slash disposal areas away from all cultural resource sites.

B. PROTECTION OF SENSITIVE NATURAL RESOURCES

Actions to prevent or mitigate negative impacts:

- Conduct prescribed burns outside breeding seasons.
- Create patchy burns leaving mosaics of vegetation that are refuges for animals and sources of reseeding.
- Keep up-to-date survey records of special status species.
- Locate potential firebreaks, staging camps and spike camps ahead of fire.
- Avoid using aircraft where it might disrupt nesting.
- Add rare species to GIS databases and continuing to build knowledge of life histories.
- Use refueling stations that protect against gasoline spills.
- Carry out rehabilitation immediately after fire if needed.
- Restrict prescribed fire to low and moderate intensity.
- Use Minimum Impact Suppression Techniques whenever possible.
- Measures specific to support Mexican long-nose bat include burning when the bat is wintering in Mexico, ensure 80 percent of agaves are maintained by patchy prescribed burns or suppression of wildland fire if needed, consult resource specialist.
- Follow Recovery Plan guidelines for federally listed species.
- Measures specific to support black-capped vireo include thinning and prescribed burns to protect key occupied territories, continue monitoring and do research on why suitable sites are not occupied, suppress any wildland fire that threatens territories, conduct any nearby burn outside the nesting and fledgling season.
- Measures specific to support Chisos Mountain hedgehog cactus include ongoing research into population dynamics, establishment and the removal of buffelgrass near affected individuals or populations.
- Measures specific to support Big Bend gambusia include ongoing monitoring, periodic reduction of giant reed to

prevent high-intensity fire, prevention of fuels and suppression chemicals from entering the ponds, protection of cottonwoods against fire, restoration, replanting, and other habitat augmentation if needed following fire.

- Manage wilderness in accordance with the Wilderness Act including: hand tools rather than mechanized tools and aircraft; fugitive retardant if it must be use; avoid spills, foam or erosion near water.
- Limit erosion following high-severity fire by creation of silt catchment devices at key points.

As personnel trained to identify and mitigate suppression impacts and recommend post-fire rehabilitation measures, resource advisors will assess burn areas that exceed 100 acres or fires of any size that occur in sensitive habitats. Sensitive habitats include habitat for state or federally listed species as well as locally rare plant communities such as in the High Chisos and desert riparian/spring areas.

C. MODERN INFRASTRUCTURE AND DEVELOPMENTS

Urban-interface mitigation techniques for eliminating and/or reducing potential wildland fire fuel hazards will be applied to prevent or reduce negative impacts to modern developments within and adjacent to the boundaries of the park. Considerable private development at Lajitas, in Terlingua Ranch and Study Butte does exist adjacent to Big Bend National Park. The owners of these properties, along with other members of the general public, will be informed of methods of acceptable wildland fuel hazard mitigation through the Park's public information programs and normal neighbor contact.

XI FIRE CRITIQUES AND ANNUAL PLAN REVIEW

This Fire Management Plan and its appendices will be reviewed annually by the Fire Management Officer and other park or fire personnel as requested by the Fire Management Officer. The review will take place after the current fire season and before the next fire season. The purpose of this review is to assure that fire management planning documents are pertinent and up-to-date with current policy and operational procedures. Revisions will be undertaken as necessary to assure this purpose is met. Environmental documents will be revised or new documents will be prepared when plan revisions result in anticipated changes in the intensity or frequency of environmental impacts than discussed in the 2005 documents.

A. FIRE REVIEW

All wildland and prescribed fires will be reviewed in accordance with Director's Order-18 (2003) and Reference Manual-18, Chapter 13, Evaluation and Review (1999). The authority to convene a fire review rests with the park superintendent, regional director, or the Associate Director, Park Operations and Education. It is the clear responsibility of the park superintendent to call for a review, to insure timely completion, and to implement recommended actions

The after action review should identify what went right and where improvement is needed. The review is to identify areas that can be improved upon through training, change in procedure, improved communication, etc. Special recognition should be given to those that put forward extra effort to accomplish their duties and help meet the goals and objectives of the incident. Also any cooperators should be recognized. Any changes in procedure(s) should be made immediately and broadcast to all those that may be involved. Training deficiency should be corrected as soon as required training is available.

B. ANNUAL FIRE SUMMARY REPORT

The FMO will be responsible for completing an annual Wildland Fire Summary Report. The report will contain the number of fires by type, acres burned by fuel type, cost summary, personnel utilized, hours of aircraft used, and fire effects.

XII CONSULTATION AND COORDINATION

The first internal scoping meeting for this project was held on December 11 & 12, 2002. Big Bend National Park personnel and staff from University of Arizona's School of Natural Resources reviewed an NPS Intermountain Region Environmental Screening Form, identified important park resources, and began discussing options for fire management. The research specialists from the University of Arizona's School of Natural Resources were added to this team (referred to below as the NPS/UA team) in order to assist with compiling information and writing the Environmental Impact Statement (EIS). An additional 5 internal meetings were held over the course of this project.

On June 10, 2003, a newsletter outlining the proposed EIS fire management alternatives and inviting comments was mailed out to 217 members of the public on the Big Bend NP mailing list. Public scoping meetings were held in Alpine and Study Butte, Texas on June 26-27, 2003. The team received few responses as a result of this newsletter and the scoping meetings.

The team began informal discussions with the U.S. Fish and Wildlife Service and the Texas Department of Parks and Wildlife on November 20, 2003 to identify species of concern. On January 27, 2004, the first informal review of Biological Assessment by USFWS began and on July 10, 2004, a second informal assessment of BA by US FWS began. On May 18, 2004, the Texas Parks and Wildlife Service began an informal review of draft BA.

In May, 2004 the park initiated consultation with TX SHPO for National Historic Preservation Act Section 106 compliance.

On 17 December, 2004 a Notice of Intent to change the Environmental Impact Statement (EIS) to an Environmental Assessment (EA) appeared in the Federal Register. The rationale for change was that the assessment of effects was not significant for any of the impact topics identified for analysis. Park staff believed that the fire management plan would not be controversial, which was borne out by the few comments received from the public during the 30 day comment period.

The EA was reviewed by the NPS Intermountain Regional Office in May, 2005. A Cultural Resources Component was prepared and sent to the Texas State Historic Preservation Office, along with the EA, for review in June 2005 and concurred in a letter dated July 12, 2004. The BA and a copy of the EA was sent to the U.S. Fish & Wildlife Service office in Austin,

for a review of the federally listed wildlife section on June 1, 2005, and a Biological Opinion was issued by the USFWS on September 20, 2005 under Consultation Number 2-15-00-F-0572.

The EA was made available for public comment on June 1, 2005 for 30-days. Six comments were received with none disagreeing with the findings of the EA. A Finding of No Significant Impact (FONSI) was signed the last week of September, 2005.

A. WILDLAND FIRE MANAGEMENT PLAN, AGENCIES CONSULTED

- Intermountain Regional Office, National Park Service
- Texas Parks and Wildlife Department
- Texas Forest Service
- Lincoln Zone Interagency Coordination Center
- US Fish and Wildlife Service
- Texas State Historical Preservation Office
- The Nature Conservancy of Texas

B. WILDLAND FIRE MANAGEMENT PLAN, PERSONS CONSULTED

- Harry Phillips, Center Manager, Lincoln Zone Interagency Dispatch Center, 420 Barrett St., Alamogordo, NM 89725
- Bill Davis, Regional Fire Coordinator, Texas Forest Service, Fort Stockton, TX
- Tom Santry, Emergency Management Coordinator, Brewster County, TX

C. WILDLAND FIRE MANAGEMENT PLAN PREPARATION

Five broad groups of people prepared the information for this FMP.

- *Interdisciplinary Team (IDT)*: The IDT is composed of NPS staff that is ultimately responsible for carrying out the plan. The staff has expertise in natural and cultural resources, fire operations, park administration, and visitor services. The Big Bend team also included a partner from the University of Arizona who served as overall editor for the EA.
- *Other Agency Cooperators*: Development of the plan included consultation with U.S. Fish and Wildlife Service, and Texas Parks and Wildlife on threatened and endangered species. The Black Gap

Wildlife Management Area and Big Bend Ranch Park are being consulted about fire along park boundaries. The Texas State Historical Preservation Office was consulted about cultural resources.

- *Tribal Governments:* The seven tribes affiliated with the park are Apache Tribe of Oklahoma, Blackfeet, Comanche Tribe of Oklahoma, Kickapoo Traditional Tribe of Texas, Kiowa Tribe of Oklahoma, Mescalero Apache Tribe, and Ysleta Del Sur Pueblo.
- *Mexican Preserves:* The managers of the protected areas, Maderas del Carmen in the state of Coahuila, and Canyon de Santa Elena in the state of Chihuahua received notice of the park's planning process and were invited to participate. No comments were received. The preserve managers will continue to be invited to participate in planning meetings and efforts will be made to ensure they can attend meetings that jointly benefit management and operations of the park and preserves.
- *Interested Public:* The written comments of people who attended public scoping meetings, neighbors, and other interested members of the public have been considered during the development of the EA and FMP.

APPENDICES

A: LITERATURE CITED

B: GLOSSARY

C: SPECIES LISTS

D: NEPA AND NHPA COMPLIANCE

E-1a: FIRE CALL-UP LIST

E-1b: FIRE QUALIFICATIONS

E-2: COOPERATIVE AGREEMENTS

F: WILDLAND AND PRESCRIBED FIRE MONITORING PLAN

G: PRE-ATTACK PLAN

**H-1: LONG-TERM PRESCRIBED FIRE AND HAZARD FUEL
REDUCTION PLAN**

H-2: EXAMPLE PRESCRIBED BURN PLAN

I: FIRE PREVENTION PLAN

J: WEATHER STATION CATALOGUES

**K: WILDLAND FIRE IMPLEMENTATION PLAN
RESOURCES**

**L: BURNED AREA EMERGENCY STABILIZATION AND
REHABILITATION PLAN**

M: EXAMPLE DELEGATION OF AUTHORITY

N: INCIDENT COMPLEXITY ANALYSIS

Appendix A

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Appendix B Glossary

The NWCG Glossary (2005) is the reference document for fire terminology. It provides the wildland fire and fire use communities a single source document that covers wildland fire, prescribed fire, fire use and incident management terminology commonly used by the National Wildfire Coordinating Group (NWCG) and its Working Teams. The following glossary is not the NWCG glossary, but a summary of terms from this Fire Management Plan.

Glossary

Appropriate Management Response (ARM)	Any specific action suitable to meet Fire Management Unit (FMU) objectives. Typically, the ARM ranges across a spectrum of tactical options (from monitoring to intensive management actions). The ARM is developed by using Fire Management Unit strategies and objectives identified in the Fire Management Plan.
Biological Assessment (BA)	An assessment presented to U.S. Fish and Wildlife Service of effects on federally listed species, proposed listed species, or critical habitats of proposed federal actions that are not major construction projects (in this particular case, implementing a new FMP is the proposed action)
Biological Opinion (BO)	The opinion of the U.S. Fish and Wildlife Service on whether or not a proposed federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat
Context	The geographical or temporal environment of a proposed action, such that a change in the action relative to space or time might alter impacts
Control, contain, confine	A sequence of progressively less aggressive actions applied to wildland fire. <i>Control</i> consists of actions to suppress fire including installing firelines and suppressing hot spots, <i>contain</i> keeps fire within established boundaries and <i>confine</i> typically allows fire to burn itself out within a natural or constructed fireline.
Cultural Landscape	Landscapes as affected by people through time— the definition of such captures overlapping occupancy by different groups of people

Glossary

Cultural Resources	Valued aspects of a cultural system that might be tangible (districts, sites, structures, objects)
Cultural Resources Component (CRC)	Document analyzing effects of the proposed action on cultural resources for review by the State Historic Preservation Office
Cumulative Effect	Effects of actions (those in the past, present, or reasonably foreseeable future) that have an additive impact on the resources affected by the proposed action
Debris Flow	“Rivers” of earth, rock, and debris saturated with water; one cause is intense summer thunderstorms following removal of organic matter from soils by fire
Direct Effect	An impact that occurs as a result of the proposed action or alternative in the same place and at the same time as the action
Duration	The length of time of effects of an action
Duff	Decomposing organic matter lying beneath the litter layer and above mineral soil
Ecoregion	A large-scale area with a common geological and biological history
Exotic Species (also non-native)	Species not native to a particular ecosystem
Fire break	A natural or manmade barrier to fire, such as a river, road, or excavated line, that is devoid of flammable vegetation
Fuel continuity	Describes how connected fuels are horizontally across the ground and vertically into canopies; continuous fuels support fire spread
Fire frequency/return interval/ fire cycle	The recurrence of fire in a given area/habitat over time
Fire intensity	The amount of energy released by the fire usually measured as per unit length of fire front; reported as low, moderate or high
Fuel moisture	Most important determinant of flammability; varies daily within plants but over a lifetime plants become drier and more flammable as they mature

Glossary

Fire severity	Qualitative measure of mortality and survival on above ground plants and animals and below ground effects on loss of organic matter; determined by heat released; little organic matter is removed or tree canopy scorched under low severity, while high severity signals very hot burns removing soil organic matter and burning forest canopy
Fire Management Plan (FMP)	The plan that guides all fire-related activities at a park that is consistent with land and resource management plans and follows NPS guidelines
Fire Management Unit (FMU)	A delineated area of the park that permits particular fire management strategies
Fuel	Vegetation, both living and dead, capable of burning
Fuel management	The use of methods such as prescribed fire and manual and mechanical means to reduce flammable vegetation that accumulates over time
Impairment	Impacts on resources that negatively, significantly, and possibly irreversibly alter their character from the state that made them important to protect in a park
Ground fire	Burns down through the litter into the duff and organic matter; can kill roots and destroy soil seedbanks
Indirect effect	An impact that occurs as a result of the proposed action, but removed in time and space from the action
Intensity	Magnitude of effect, from low to high
Inter-disciplinary team (IDT)	Group of interdisciplinary specialists that identifies important issues, relationships, and alternatives for public scrutiny
Manual fuel reduction	Removal of vegetation or creation of fire breaks using hand tools and chainsaws
Mechanical fuel reduction	Removal of vegetation or creation of fire breaks by bulldozer or road grader
Minimum requirement	The lowest impact means of accomplishing a task, frequently considered with respect to wilderness
Mitigation	Modification of an action that lessens intensity of its impacts on a particular resource

Glossary

Monitoring program	Collecting information in a systematic way on species, species distribution, growth, fuel loading and health, archeological remains, before and after prescribed burning and after natural ignitions
National Environmental Policy Act (NEPA)	The 1969 law that dictates the objective analysis and public scrutiny of the environmental as well as social and economic impacts of proposed federal actions and their alternatives prior to implementation
Natural resources	A feature of the natural (physical and biological) environment that has value to humans
No Action	Under NEPA, No Action continues the current planning and operational direction and provides a baseline against which other alternatives can be measured
Non-fire treatments	Removal of vegetation without using fire, most commonly through mechanical/manual means including mowing, slashing, chainsaws or herbicidal treatments
Non-native species	Species not native to a particular ecosystem (used like "exotic")
Prescribed fire	Any fire ignited by management actions to meet specific objectives. A written, approved prescribed fire plan must exist, and NEPA requirements (where applicable) must be met, prior to ignition.
Prescription	Measurable environmental criteria, particularly temperature, relative humidity, wind speed and direction, and fuel moisture, that define the conditions under which a fire would be ignited by management, guide selection of appropriate management responses, and indicate other required actions
Research burn	Prescribed burns with greater investment in examining, recording, analyzing, evaluating and applying monitoring results of fire effects and fire dynamics to management decisions
Resource advisor	An expert in a particular resource area (such as an archeologist or botanist) who is brought on site to advise fire crews relative to protecting sensitive resources
Rhizome	Creeping stem growing beneath the soil surface sending up new leaf shoots from nodes; characteristic of lechuguilla, saltcedar and Bermuda grass

Glossary

Root crown	Mass of woody tissues from which stems and roots originate; usually applied to shrubs and herbaceous plants; often indicates drought tolerance and ability to resprout after fire
Scoping	Compilation of knowledge and opinions in order to properly develop and decide on alternative courses of action, both internally to the park and externally with the public
Sensitive species	Species sensitive to perturbation from the proposed action, frequently rare species that are federal or state-listed, proposed for listing, occurring in very few places, or particularly sensitive to the action's impacts
Species diversity	A measure of the number of species in an area (species richness) that also accounts for species abundance
State Historic Preservation Office	The state office overseeing protection of cultural resources
Succession	The natural evolution of biotic communities over time following disturbance
Suppression	All the work of extinguishing a fire beginning with its discovery, using confine, contain, and control actions
Thinning	Reduction of density of vegetation, frequently using non-fire means
Timing	How effects vary depending on when the action takes place
U. S. Fish and Wildlife Service	U.S. Department of Interior agency charged with overseeing protection of threatened and endangered species
Unique Sites	Sites sufficiently uncommon such that their presence is a special feature of the park with intrinsic value and of interest to visitors
Unique Stands	Patches of vegetation that are uncommon in an area that may be relicts from an earlier age
Watershed	Land above a given point in a drainage that potentially contributes water to the streamflow at that point
Wilderness	Designated area managed to perpetuate natural processes and minimize human impacts
Wildfire	An unplanned, unwanted wildland fire including

Glossary

unauthorized human-caused fires, escaped wildland fire use events, escaped prescribed fire projects, and all other wildland fires where the objective is to put the fire out.

Wildland fire Any non-structure fire that occurs in the wildland. Three distinct types of wildland fire have been defined and include wildfire, wildland fire use, and prescribed fire.

Wildland Fire Use (WFU) The application of the appropriate management response to naturally-ignited wildland fires to accomplish specific resource management objectives in pre-defined designated areas outlined in Fire Management Plans. Operational management is described in the Wildland Fire Implementation Plan (WFIP).

Appendix C Species List

Plant and Animal Species referred to in this FMP

Acorn woodpecker (*Melanerpes formicivorus*)

Alkali sacaton (*Sporobolus airoides*)

Alligator juniper (*Juniperus deppeana*)

Arizona cypress (*Cupressus arizonica*)

Beaver (*Castor canadensis*)

Bear grass or Sacahuista (*Nolina microcarpa*)

Beebrush (*Aloysia gratissima*)

Bermuda grass (*Cynodon dactylon*)

Big Bend gambusia (*Gambusia gaigei*)

Bighorn desert sheep (*Ovis canadensis* spp.)

Bigpod bonamia (*Bonamia ovalifolia*)

Bigtooth maple (*Acer grandidentatum*)

Black bear (*Ursus americanus mexicanus*)

Black-capped vireo (*Vireo atricapilla*) Federally listed requiring reasonable and prudent measures.

Black grama (*Bouteloua eriopoda*)

Black phoebe (*Sayornis nigricans*)

Black-tailed jackrabbit (*Lepus californicus*)

Black-tailed rattlesnake (*Crotalus molossus*)

Blue grama (*Bouteloua gracilis*)

Bobcat (*Lynx rufus*)

Broadtail hummingbirds (*Selasphorus platycercus*)

Buffelgrass (*Pennisetum ciliare*)

Bull mushily (*Muhlenbergii emersleyi*)

Bunched cory cactus (*Coryphantha ramillosa*)

Bushtits (*Psaltriparus minimus*)

Cactus wren (*Campylorhynchus brunneicapillus*)

California cottontop (*Digitaria californica*)

Candelilla (*Euphorbia antisiphilitica*)

Catclaw Acacia (*Acacia constricta*)

Catclaw Mimosa (*Mimosa aculeaticarpa* var. *biuncifera*)

Ceniza (*Leucophyllum minus*)

Chino grama (*Bouteloua breviseta*)

Chisos agave (*Agave glomeruliflora*)

Chisos coral root (*Hexalectris revoluta*)

Chisos hophornbeam (*Ostrya chisosensis*)

Chisos metalmark (*Apodemia chisosensis*)

Chisos Mountain or Lateleaf oak (*Quercus tardifolia*)

Chisos Mountain hedgehog cactus (*Echinocereus chisoensis* var. *chisoensis*) Federally

listed requiring reasonable and prudent measures.

Chisos pinweed (*Lechea mensalis*)

Chaffey's cory cactus (*Escobaria* var. *chaffeyi*)
Coachwhip snake (*Masticophis flagellum*)
Coahuila oak (*Quercus polymorpha*)
Colima warbler (*Streptanthus cutleri*)
Common black hawk (*Buteogallus anthracinus*)
Common reed (*Phragmites australis*)
Cottonwood (*Populus deltoides* var. *fremontii*)
Coyote (*Canis latrans*)
Creosote (*Larrea tridentata*)
Curve-billed thrasher (*Toxostoma curvirostre*)
Cutler's Twistflower (*Streptanthus cutleri*)
Dalea spp. (approximately 12 species)
Deer muhly (*Muhlenbergia rigens*)
Dense cory cactus (*Escobaria dasyacantha* var. *dasyacantha*)
Desert willow (*Chilopsis linearis*)
Dog cholla (*Opuntia schottii*)
Douglas fir (*Pseudotsuga menziesii*)
Duncan's cory cactus (*Coryphantha duncanii*)
Elf owls (*Micrathene whitneyi*)
Emory oak (*Quercus emoryi*)
Evergreen sumac (*Rhus virens* var. *choriophylla*)
Fragrant ash (*Fraxinus cuspidata*)
Giantreed (*Arundo donax*)
Glass Mountain coral root (*Hexalectris nitida*)
Gnatcatchers (*Polioptila caerulea*)
Golden eagle (*Aquila chrysaetos*)
Golden-spined prickly pear (*Opuntia aureispina*)
Graves oak (*Quercus gravesii*)
Gray breasted jay (*Aphelocoma ultramarina*)
Gray fox (*Urocyon cinereoargenteus*)
Gray hawk (*Asturina plagiata*)
Gray oak (*Quercus grisea*)
Greater western mastiff bat (*Eumops perotis californicus*)
Green sprangletop (*Lepochloa dubia*)
Guayacan (*Guaiacum angustifolium*)
Guadalupe fescue (*Festuca ligulata*)
Hairy grama (*Bouteloua hirsuta*)
Harvard agave (*Agave harvardiana*)
Harvard's stonecrop (*Sedum harvardii*)
Harvard plum (*Prunus harvardii*)
Hetchia or falseagave (*Hechtia texensis*)
Hinckley's oak (*Quercus hinckleyi*)
Javalina (*Pecari tajacu*)
Johnson grass (*Sorghum halepense*)
Leatherstem (*Jatropha dioica*)
Lechuguilla (*Agave lechuguilla*)

Lehmann lovegrass (*Eragrostis lehmanniana*)
 Little-leaf brogniartia (*Brogniartia minutifolia*)
 Lloyd's Mariposa cactus (*Sclerocactus mariposensis*)
 Loggerhead shrike (*Lanius ludovicianus*)
 Long-spur colombine (*Aquilegia longissima*)
 Lovegrass (*Eragrostis* spp.)
 Mariola (*Parthenium incanum*)
 Mesquite (*Prosopis glandulosa*)
 Mexican buckeye (*Ungnadia speciosa*)
 Mexican gray wolf (*Canis lupus baileyi*)
**Mexican long-nosed bat (*Leptonycteris nivalis*) Federally listed
 requiring reasonable and prudent measures.**
 Mexican pinyon (*Pinus cembroides*)
 Mexican spadefoot toad (*Spea multiplicata*)
 Mockingbird (*Mimus polyglottos*)
 Mountain lion (*Puma concolor*)
 Mountain mahogany (*Cercocarpus montanus*)
 Mule deer (*Odocoileus hemionus*)
 Netleaf oak (*Quercus rugosa*)
 Northern Aplomado falcon (*Falco femoralis septentrionalis*)
 Northern flicker (*Colaptes auratus*)
 Ocotillo (*Fouquieria splendens*)
 Peregrine falcon (*Falco peregrinus*)
 Pinyon ricegrass (*Pipochaetum fimbriatum*)
 Ponderosa pine (*Pinus ponderosa*)
 Prickly pear (*Opuntia* spp.)
 Puckering nightshade (*Nectouxia formosa*)
 Purple gay mallow (*Batesimalva violacea*)
 Redberry juniper (*Juniperus pinchottii*)
 Red oak (*Quercus rubra*)
 Resurrection fern (*Selaginella lepidophylla*)
 Rio Grande leopard frog (*Rana berlandieri*)
 Roadrunner (*Geococcyx californianus*)
 Robert's stonecrop (*Sedum robertsianum*)
 Rock Squirrel (*Spermophilus variegates*)
 Rufous towhe (*Pipilo erythrophthalmus*)
 Russian thistle (*Salsola kali*)
 Saltcedar (*Tamarix ramosissima*)
 Scott's oriele (*Icterus parisorum*)
 Screech owls (*Otus asio*)
 Screwbean (*Prosopis pubescens*)
 Scrub Oak (*Quercus turbinella*)
 Sea urchin cactus (*Echinocactus asterias*)
 Shorthorn jefea (*Jefea brevifolia*)
 Shrubby groundsel (*Baccharis halimifolia*)
 Sideoats grama (*Bouteloua curtipendula*)

Sierra del Carmen oak (*Quercus carmenensis*)
 Sierra del Carmen whitetail deer (*Odocoileus virginianus*)
 Silver-spined cholla (*Opuntia imbricata* var. *argentea*)
 Skeletonleaf goldeneye (*Viguiera stenoloba*)
 Slender Oak or Chisos oak (*Quercus graciliformis*)
 Slimleaf vauquelinia (*Vauquelinia corymbosa* subsp. *angustifolia*)
 Slimleaf rosewood (*Vauquelinia corymbosa* var. *heterodon*)
 Southwestern willow flycatcher (*Empidonax traillii extimus*)
 Sotol (*Dasyilirion wheeleri*)
 Striped Skunk (*Mephitis mephitis*)
 Swallow spurge (*Chamaesyce golondrina*)
 Tall-stemmed paintbrush or Squawflower (*Castilleja elongata* or *C. integra* var. *integra*, taxonomy questionable)
 Tarbush (*Flourensia cernua*)
 Texas antelope (*Antilocapra americana* and *A. mexicana*)
 Texas hornshell (*Popenaias popei*)
 Texas horned lizard (*Phrynosoma cornutum*)
 Texas largeseed bittercress (*Cardamine macrocarpa* var. *texana*)
 Texas madrone (*Arbutus xalapensis [texana]*)
 Texas persimmon (*Diospyros texana*)
 Texas purple spike (*Hexalectris warnockii*)
 Three-awns (*Aristida* spp.)
 Three-tongued spurge (*Chamaesyce chaetocalyx* var. *triligulata*)
 Tobosagrass (*Hilaria mutica*)
 Trans-Pecos maidenbush (*Andrachne arida*)
 Trans-Pecos rat snake (*Bogertophis subocularis*)
 Turkey vulture (*Cathartes aura*)
 Two-Bristle rock daisy (*Perityle bisetosa* var. *bisetosa*)
 Variable oakleaf caterpillar (*Lochmaeus manteo*)
 Weeping juniper (*Juniperus flaccidus*)
 Western diamondback rattlesnake (*Crotalus atrox*)
 Western pipistrelle (*Pipistrellus Hesperus*)
 White column cactus (*Escobaria albicolumnaria*)
 Willow, Goodding (*Salix gooddingii*), Black (*S. nigra*), Coyote (*S. exigua*)
 Wright silktassel (*Garrya wrightii*)
 Yellow bells (*Tacoma stans*)
 Yellow-billed cuckoo (*Coccyzus americanus*)
 Yellow-breasted chat (*Icteria virens auricollis*)
 Yellow-nosed cotton rat (*Sigmodon ochrognathus*)
 Yucca (6 *Yucca* spp.)

Appendix D: NEPA and NHPA COMPLIANCE

(Insert CD he

Appendix E-1A 2005 Wildland Fire Call out list, June 30, 2005
Initial callout will be made to Fire Management Staff

Fire Staff		Work Phone	Home Phone
John Morlock	(460)	477-2397	477-2381
Gary Luce	(462)	477-2554	477-2468
Joe Roberts	(463)	477-2554	386- 4346 (Marathon)
Chris Wood	(465)	477-2554	477-2338
Reine Wonite	(467)	477-2554	477-2595
Jeremiah Marsh	(466)	477-2554	477-2338
John Zubia	(471)	477-2509	Try LE Emory
Richard Gatewood	(470)	770-8785(Alpine)	837-1456
Nicola Stringer	(472)	477-2510	477-2338
Jess Erickson	(473)	477-2510	477-2468
Heather Dammeyer	(474)	477-2510	477-2690

Park Staff

Aaron Scott		477-2225	477-2384
Amy Davis		477-1187	477-2412
Brian Sikes		477-2225	477-2261
Dan Leavitt		477-1185	477-2564
Dan Muntean		477-1133	477-2345
David Elkowitz		477-1107	477-2595
David Van Inwagen		477-2597	477-2521
David Yim		477-2392	477-2447
Don Corrick		477-1142	477-2306
Don Sharlow		477-1124	477-2395
Eric Leonard		477-1196	477-2621
Joe Sirotnak		477-1148	477-2028
Nathan Dammeyer		477-1148	477-2690
John Lowe		477-1131	477-2553
Ron Sams		477-2392	477-2689
Laura Van Inwagen		477-1180	477-2521
Mark Spier		477-1185	477-2463
Mark Spurlock		477-2264	
Mark Yuhas		477-1133	477-2389
Jeff Sartain		477-2288	477-2526
Mike Ryan		477-1137	477-2330
Monica Foster		477-1187	477-2323
Nick Herring		477-1138	477-2226
Radford Dew		477 1138	
Raymond Skiles		477-1145	477-2232
Jeff Bennett		477-1141	477-2657
Scott Jacobs		477-2356	477-2323

Steve Benavidez
Tom Alex

477-1128
477-1144

477-2406
477-2254

BOLD LETTERS INDICATES THEY ARE NOT TO BE ASSIGNED A FIRELINE POSITION. Reference Appendix E-1a for other qualifications.

Appendix E-1b**2005 Wildland Firefighters****Qualifications List** (March 24, 2005)**Fire Staff**

John Morlock	(460)	CREP, DIVS, ENGB, FIRB.FOBS, ICT3, SITL, TFLD,RXB2,EMTB
Gary Luce	(462)	CRWB,ENGB, FALB, RXI2, ICT4-T, FEMO-T, HECM-T
Joe Roberts	(463)	FFT1, ENOP, CRWB-T, ENGB-T, HECM-T
Chris Wood	(465)	FFT2, FFT1-T, HECM-T
Jeremiah Marsh	(466)	FFT2, HECM, EMT
John Zubia	(471)	CRWB, ENGB, ICT4, FIRB, HECM, HCWN, RXI2, FOBS
Richard Gatewood	(470)	FFT1-T, FALB, FEMO
Lori Bush	(461)	Dispatch, Expanded Dispatch

Park Staff

Don Corrick Geologist		HECM, FFT2, Archeologist Resource Advisor,
Tom Alex		FFT2, Archeologist Resource Advisor
David Elkowitz		FFT1, FEMO, PIO2, FOBS-T
John Lowe		HECM, HCWN-T
Don Sharlow		HCWN, HEMG-T, FALC
Mark Spier		FFT1, CRWB, ICT4, ICT3, EMT
Amy Davis		IADP, FFT2, Expanded Dispatch
Mike Ryan		FFT1, FFT2, HECM??need to confirm..
Mark Spurlock		Equipment MGR-T

Park Staff and Trail Crew all FFT2**Work****Home**

Aaron Scott	477-2225	477-2384
Brian Sikes	477-2225	477-2261
Dan Leavitt	477-1185	477-2564
Dan Muntean	477-1133	477-2345
David VanInwagen	477-2597	477-2521
David Yim	477-2392	477-2447
Eric Leonard	477-1196	
Jake Szympruch	477-2356	477-2444
Jessica Erickson	477-1187	477-2468
Joe Sirotnak	477-1148	477-2028
Kyle Green	477-1118	477-2228
Laura VanInwagen	477-1180	477-2521
Mark Yuhas	477-1133	477-2389
Meghan Hicks	477-1187	477-2419
Monica Foster	477-1187	477-2323
Nick Herring	477-1138	477-2226
Raymond Skiles	477-1145	477-2232
Scott Jacobs	477-2356	477-2323

Steve Benevides
Whitt Hibbard

477-1128
477-2225

477-2406

Trail Crew FFT2 and some HECM-T

Erik Walker (work leader)

477-2338

Cell—513 255 1270

Maria Lavender

477-2338

Cell—513 255 1270

Mark Kneeskern

477-2338

Danica Celix

477-2338

Barry Lockwood

477-2338

Appendix E-2 Cooperative Agreements

A44 (BIBE)

Agreement Number G7130020001

**GENERAL AGREEMENT
BETWEEN
BIG BEND NATIONAL PARK
RIO GRANDE WILD AND SCENIC RIVER
AND
BREWSTER COUNTY, TEXAS
FOR
EMERGENCY SERVICES**

Article I - Background And Objectives

This agreement is entered into by and between the National Park Service (hereinafter NPS), United States Department of the Interior, acting through the Superintendent of Big Bend National Park (hereinafter Park), and Brewster County (hereinafter County), acting through its County Judge. The purpose of this agreement is to establish the terms and conditions under which the parties will provide mutual emergency assistance for occurrences of structural fires, vehicle fires, wildland fires, medical services, hazardous materials spills, and search and rescue operations on lands within the Park's boundaries and in the near-by surrounding County area.

Article II - Legislative Authority

This agreement is entered into under the authority of 42 U.S.C. § 1856a (2000), and 16 U.S.C. §§ 1-3.

Article III - Statement of Work

A. The NPS agrees to:

1. Furnish, when requested by the County, available, qualified personnel and equipment to assist with emergency occurrences of structural fires, vehicle fires, wildland fires, medical services, hazardous materials spills, and search and rescue operations within the surrounding area outside the Park boundary. Qualified NPS employees authorized by a supervisor to respond shall be deemed to be on-duty and acting within the scope of their federal employment when responding to calls outside the Park.
2. Provide, as requested, to the County, familiarization tours of the Park's facilities, equipment, and access points.

B. The COUNTY agrees to:

1. Furnish, when requested by the Park, available, qualified personnel and equipment to assist with emergency occurrences of structural fires, vehicle fires, wildland fires, medical services, hazardous materials spills, and search and rescue operations on federally owned land within the Park.
2. Provide, as requested, to the Park, familiarization tours of the County's facilities and equipment.

C. The parties further agree as follows:

1. The County and the NPS each acknowledge and agree that the County is not the employer of the personnel who provide fire fighting and emergency medical services within the County. It is agreed and understood that other nonprofit or for profit agencies are the employers of these categories of emergency responders who are working in Brewster County, and as such, the County exercises no direct control or supervision over firefighters and emergency medical service personnel. However, Brewster County agrees that it will use its best efforts to secure the cooperation of the nonprofit and for profit agencies and the employees of these agencies in abiding by the terms of this agreement.
2. Each party shall provide to the other a list of responsible persons, with telephone numbers, to be contacted in an emergency. At least once a year, or more often if necessary, each party shall provide the other party with an updated list of such persons and telephone numbers.
3. Each party shall provide to the other copies of current applicable emergency operations plans for their areas of primary responsibility, including maps of areas involved and descriptions of special or extraordinary actions to be taken.
4. Each party to this agreement waives all claims against the other for compensation for any loss, damage, personal injury, or death occurring in consequence of the performance of this agreement.
5. Neither party to this agreement shall reimburse the other for any or all costs incurred by such party in providing services pursuant to this agreement.
6. Nothing contained herein shall be construed as limiting in any way the responsibility and authority as defined by law, of the Superintendent, Big Bend National Park and the County Judge, Brewster County, in connection with the management and protection of lands and resources under their respective administrative jurisdictions.

7. Nothing contained herein shall be construed as limiting in any way the responsibility and authority of each party's personnel to carry-out their responsibilities in accordance with their employing party's policy and training.
8. It is agreed that each party will be solely responsible for the acts and omissions of its ! officers, employees, and volunteers, to the same extent as each party is presently responsible under applicable laws and regulations.
9. During an emergency, the highest ranking representative of the party with administrative jurisdiction over the area in which the emergency occurs, or his/her designee, will be the Incident Commander and will be responsible for the direction of the emergency response efforts, unless the emergency is first reached by representatives of the other party, in which case they will assume the responsibility of Incident Command. When a representative of the party with administrative jurisdiction over the area arrives, the Incident Commander will relinquish the duties of Incident Commander to the representative of the agency with administrative jurisdiction, and will cooperate with that representative in the ongoing emergency response efforts.
10. The highest ranking representative of each party who is present at the scene will supervise that party's employees and will control the method and manner of its employees' work. Nothing in this agreement is intended to alter the parties' usual chain of command. The Incident Commander will communicate only with the highest ranking representative of the other party who is present at the scene. For good cause the highest ranking representative of either party may decide at any time to withdraw emergency assistance.
11. NPS employees rendering emergency assistance to Brewster County under this agreement shall wear the official NPS or park approved uniform and personal protective equipment; shall be subject to the laws and policies of the NPS and of the United States; and may not accept compensation from any source other than the NPS.
12. After notifying the other party of an emergency and receiving a request for assistance, either party may take immediate action to suppress or mitigate the emergency in the other party's area of primary responsibility in order to save life or property.
13. Neither party shall jeopardize the security of their area by over-committing available personnel and equipment to an ongoing emergency in the territory of the other party. The amount of resources to be committed will be determined solely by the responsible authority of each party.
14. The parties shall make available and share their respective emergency radio frequencies for both monitoring and transmission, and provide radio dispatch services as requested.

15. As mutual training and equipment familiarization will be of great benefit during any emergency, each party agrees to notify the other of available training and participate in joint training exercises when possible.

Article IV - Term of Agreement

This agreement shall be effective for a period of five years from the date of final signature, unless it is terminated earlier by one of the parties pursuant to article IX that follows. At the conclusion of that five-year term, this agreement may be extended or renewed by written agreement of the parties.

Article V - Key Officials

All communications and notices regarding this agreement shall be directed to the following key official(s) for each party:

For the NPS:
Superintendent
Big Bend National Park
P.O. Box 129
Big Bend, Texas 79834
(915) 477-1101

For Brewster County:
Brewster County Judge
P.O. Box 1630
Alpine, Texas 79830
(915) 837-2412

Article VI - Prior Approval

Not applicable.

Article VII - Reports and/or Other Deliverables

Upon request and to the full extent permitted by applicable law, the parties shall share with each other final reports of incidents involving both parties.

Article VIII - Property Utilization

Unless otherwise agreed to in writing by the parties, any property furnished by one party to the other shall remain the property of the furnishing party. Any property furnished by the Park to the County during the performance of this agreement shall be used and disposed of as set forth in NPS Property Management Regulations.

Article IX - Modification and Termination of Agreement

This agreement may be modified only by a written instrument executed by the parties. Either party may terminate this agreement by providing the other party with sixty (60) days 'advance written notice.

Article X - Standard Clauses

A. Civil Rights

During the performance of this Agreement, the participants agree *to* abide by the terms of U.S. Department of the Interior - Civil Rights Assurance Certification, nondiscrimination and will *not* discriminate against any person because of race, color, religion, sex, or national origin. The participants will take affirmative action *to* ensure that applicants are employed without regard *to* their race, color, sexual orientation, national origin, disabilities, religion, age, or sex.

B. Public Information Release

Each party will obtain prior approval from the Key Official of the other party for any public information releases which refer *to* either the County, or the Department of the Interior (including any bureau and park unit), or employees (by name or title), or this Agreement. The specific text, layout, photographs, etc. of the proposed release must be submitted with the request for approval.

Article XI - Authorizing Signatures

In witness hereof, the following authorized representatives of the parties have signed their names on the date(s) indicated, thereby executing this agreement.

For Brewster County:

Signed by Val Beard

July 23, 2002

Val Beard, County Judge

Date

For the National Park Service:

Signed by Frank J. Deckert

July 18, 2002

Frank J. Deckert, Superintendent

Date

INTERPARK AGREEMENT

between

Big Bend National Park

and

Amistad National Recreation Area, Fort Davis National Historic Site

And Palo Alto Battlefield National Historic Site

ARTICLE I. PURPOSE

Define the mutual responsibilities of the Big Bend National Park Wildland Fire Management Staff and staff from Amistad National Recreation Area, Fort Davis National Historic Site, and Palo Alto Battlefield National Historic Site in terms of Wildland Fire Management activities.

ARTICLE II. RESPONSIBILITIES

The duties of the Big Bend National Park Wildland Fire Management Staff will include providing, as requested and required, professional and technical support for the Wildland Fire Management programs to units identified in Article I. The performance of these responsibilities will be based on an annual work plan developed by and coordinated with the National Park Service (NPS) Unit Superintendents, Fire Management Officer, and other staff as appropriate.

A. Specific responsibilities of the Fire Management Staff include:

1. Assists in development and implementation of prevention, suppression, fuels management and rehabilitation programs with appropriate staff through site visits, program reviews, inspections, budget formulation, and training.
2. Assists in coordination of reports, correspondence, preparation/review of fire management plans and participate in fire management planning as requested.
3. Assists in coordination and implementation of planned ignitions, fire effects, smoke management, fire ecology, and research programs according to park and area fire management plans.
4. Coordinates, through appropriate zone coordination centers, mobilization of National Park Service personnel for fire assignments.
5. Develops, coordinates, and conducts fire-related training as necessary to meet wildland fire needs of the units and interagency needs according to approved fire management plans, zone, field area, cluster, and national guidelines. Assists Intermountain Regional Fire Management Staff in the identification, issuance of performance task books, and certification of individuals for development of overhead positions.
6. Manage fire qualification/training records in the National Park Service Wildland Fire Computer System, including: initial record input; updating fitness scores, training, record transfer, experience, and instructor records, and issues

incident qualification cards. Big Bend will provide an annual timetable to each unit fire coordinator.

7. Communicates with respective units on issues and concerns prior to representing the SW Texas Park units at meetings, conferences, seminars, and other functions as requested and required, including the Interagency Fire Program Analysis (FPA).

8. Coordinates NPS role in the 'local' or 'zone' interagency fire community; developing interagency agreements, cooperative agreements, and other agreements necessary for carrying out wildland fire management.

B: Responsibilities of the Superintendents include:

1. Request assistance through the Fire Management Office with sufficient lead time to meet due dates, set-up meetings, etc. Each NPS Unit Superintendent will designate a Unit Fire Coordinator who requests program assistance, budget, supplies, and training needs through the Big Bend Fire Management Officer.

2. Submit personnel file updates, physical fitness scores, individual fire reports (DI- 1202), situation reports, physical exam records, and ROSS (availability) information following established times and due dates. Unit Fire Coordinators will be responsible for maintaining fire readiness to the level identified in the Park's Fire Management Plan, or if no Fire Management Plan exists, to the level agreed to by the Unit Superintendent and Fire Management Officer.

3. Notify the Big Bend Fire Management Officer as soon as practical of any fire restrictions, closures, fire occurrences, or support actions.

4. Participate in the overall Wildland Fire Management of the SW Texas Park units and of the NPS by committing to sharing of trained and available personnel upon request.

INTERPARK COORDINATION

1. The Fire Management Officer will meet with each Superintendent and/or unit fire coordinator annually to prepare a work plan for each unit. The work plan will be distributed to each unit not later than 30 January each year.

ARTICLE IV. FUNDING

1. Program costs (travel/per diem, communications, supplies & materials, etc.) incurred by the Big Bend Fire Staff will be charged to appropriate FIREPRO or FPA accounts. If personnel are working on a project which has been individually funded, the personnel may be paid from appropriate project funds.

2. Annual budgets will be developed, identifying supplemental support for park units - i.e.: physical exams, PPE, training, cache items, travel, hazard fuel reduction projects, etc., this budget request will be reflected in the FIREPRO or FPA Park's annual budget request. The budget submission will be completed not later than 30 June each year.

ARTICLE V. TERM OF AGREEMENT

The term of this Agreement will be five (5) years, beginning in fiscal year 2005. It is renewable at the end of each five-year period by written letter of agreement signed by each of the Superintendents of the SW Texas Park units.

Amendments to this Agreement can be made at any time subject to the written concurrence and approval of all Superintendents. This Agreement may be cancelled with written notification at any time by a park superintendent. The Agreement will remain in effect for the remaining parks.

ARTICLE VI. REPORTS

The Big Bend Fire Staff will supply trip reports (within 2 weeks), situation reports, and personnel file information, or other pertinent reports to each area, as requested.

ARTICLE VII. SIGNATURES

IN WITNESS HEREOF, the parties hereto have executed this Agreement on the date(s) set forth below.

Signature: _____

Signature: _____

Name: Myrna Palfrey- Perez _____

Name: Alan Cox _____

Title: Superintendent _____

Title: Superintendent _____

Palo Alto Battlefield National Historic Site

Amistad National Recreation Area

Date: _____

Date: _____

Signature: _____

Signature: _____

Name: John H. King _____

Name: Todd Brindle _____

Title: Superintendent _____

Title: Superintendent _____

Big Bend National Park

Fort Davis National Historic Site

Date: _____

Date: _____

JOINT POWERS OPERATING PLAN

LINCOLN UNIT

**AGE. NO. 16-R3-77-0003
NO. CANMSO 90**

NO. 66-4

Forest Supervisor,
Lincoln National Forest

Date

Capitan District Forester,
State of New Mexico, Forestry Division

Date

Roswell Field Office Manager,
Bureau of Land Management

Date

Las Cruces Field Office Manager,
Bureau of Land Management

Date

Carlsbad Field Office Manager,
Bureau of Land Management

Date

Mescalero Agency Superintendent,
Bureau of Indian Affairs

Date

Superintendent, **Carlsbad Caverns National Park**

Date

Superintendent,
Guadalupe Mountains National Park

Date

Superintendent,
Ft. Davis National Historic Site

Date

Superintendent,
Big Bend National Park

Date

Superintendent,
White Sands National Monument

Date

Superintendent,
Chamizal National Monument

Date

Refuge Manager,
Bitter Lake National Wildlife Refuge

Date

Hatchery Manager,
Dexter National Fish Hatchery

Date

Refuge Manager,
San Andreas National Wildlife Refuge

Date

JOINT POWERS OPERATING PLAN

This Operating Plan is between the United States Department of the Interior, National Park Service (NPS), Bureau of Land Management (BLM), Bureau of Indian Affairs (BIA), Fish and Wildlife Service (F&WS), the United States Department of Agriculture, Forest Service (USFS); and the State of New Mexico - Energy, Minerals and Natural Resources Department, Forestry Division (NMFD).

I. **Authority**

The authority for Federal agencies or organizations is as follows:

USDA, Forest Service - Section 5, Act of April 24, 1950 (16 USC 572); the Act of June 30, 1914 (16 USC 498) and the Act of September 21, 1944 (16 USC 580); the Act of December 12, 1975 (16 USC 565a-1-3) and the Annual Department of Interior and Related Agencies Appropriations Act.

USDI, Bureau of Land Management - 42 Statute 857, (16 USC 594, 48 Statute 1270; 43 USC 315a, 90 Statute 2766, 43 USC 1737.

USDI, National Park Service - 16 USC 1b (1).

USDI, Bureau of Indian Affairs - 42 Statute 857; 16 USC 594; 69 Statute 66; Section 16 of Order 2503 (Secretary of the Interior).

USDI, Fish and Wildlife Service - 42 Statute 857; 16 USC 594.

Authority applicable to all Federal agencies - Reciprocal Fire Protection Act of 1955 (42 USC 1856); and the Economy Act of June 30, 1932 (31 USC 686).

The authority for the New Mexico Forestry Division is as follows:

Sections 68-2-6 and 68-2-8 of the New Mexico Forest Conservation Act, NMSA 1978 Compilation.

Authority for this Operating Plan is derived from and part of the Joint Powers Agreement among the Energy, Minerals and Natural Resources Department and the United States Federal Agencies of the Department of Agriculture, Department of Interior with Wildland Fire Protection Responsibilities, Section 10, General Provisions, Item h, between the above mentioned Federal and State agencies, which call for the preparation and adoption of an annual operating plan.

II. **PURPOSE**

The purpose of the Operating Plan is to establish an agreement for wildland fire management and to provide initial attack procedures for the Lincoln Zone.

III. MANAGEMENT BOARD

It is agreed that the following Management Board will be established to coordinate activities within the Zone:

A. Type II and Type III Interagency Incident Management Team Board

1. Membership - This board will be made up of one (1) member from each of the following agencies:
 - a. USDA Forest Service
 - b. USDI Bureau of Indian Affairs
 - c. USDI Bureau of Land Management
 - d. USDI National Park Service
 - e. State of New Mexico EMNRD - Forestry Division
 - f. US Fish and Wildlife Service

Note: LNZ Coordination Center Rep. is not a voting member of board.

2. Duties -

The duties of this Management Board will include:

- a. Participation in the selection of the New Mexico Type II and the local zone Type III Interagency Incident Management Team members;
- b. Evaluate training needs for the Incident Management Team positions and make recommendations for training courses to the Lincoln Zone Interagency Coordination Center Management Board.

B. Lincoln Zone Interagency Coordination Center Management Board

1. This board will be made up of one (1) member from each of the following agencies:
 - a. USDA Forest Service;
 - b. USDI Bureau of Indian Affairs;
 - c. USDI Bureau of Land Management;
 - d. USDI National Park Service;
 - e. State of New Mexico EMNRD – Forestry Division;
 - f. US Fish and Wildlife Service.

2. Duties –

The duties of this board will include:

- a. See *Appendix LZCC Management Board Charter – Exhibit VI.*

IV. **RESPONSIBILITY**

It is mutually agreed that each party of this Operating Plan will retain ultimate responsibility for all fire management action on lands under its administrative jurisdiction.

V. **DEFINITIONS**

1. *Initial Attack* is that initial suppression response to a wildland fire incident;
2. *Escaped Fire* is a fire that exceeds the capabilities of the initial response forces;
3. *Reinforcements* shall mean all forces subsequent to initial attack;
4. *Initial Attack Incident Commander* is the first fire qualified supervisory person to arrive at the fire, until relieved;
5. *Jurisdictional Agency* is that agency having ultimate responsibility for fire management action on lands under its jurisdiction;
6. *Initial Attack Zones* are mutually agreed upon areas delineating initial attack responsibilities;
7. *Notification of Initial Attack Action* (See *Exhibit I*).

VI. **DESIGNATED ZONES OF RESPONSIBILITY**

1. Initial attack zones have been established based on closest and available fire protection resources and capabilities of the designated responding agency. A map of these zones is attached hereto and made a part of this Operating Plan (*Exhibit I*).
2. The designated initial attack zones are based on historical wildfire incidents and are agreed to be off-setting for Federal and non-Federal expenditures of funds, and, thereby mutually beneficial and cost-effective. It is also agreed that Federal protection cost on non-Federal lands will not exceed the protection by the State. Conversely, the State will not expend funds to a greater extent in protecting Federal lands.
3. The agency responsible for initial attack should make a reasonable effort to contact private landowners in advance of fire season. The objective of such contacts is to briefly explain the initial attack responsibilities and obtain gate keys or permission by the landowner to cut fences or gates

for access to fires. Any damage to private lands for access should be restored following control of the fire. These contacts should be made by local unit personnel who have the assigned initial attack responsibility.

VII. **SPECIFIC PROVISIONS**

1. Initial Attack Fires -

A. Communication:

- a. Each agency will submit an initial report through the Lincoln Zone coordination Center to cooperating agencies of their available resources by April 1st of each year. Refer to the procedures in the Lincoln Zone Operating Plan.
- b. Prompt verbal notification will be given to the jurisdictional agency that initial action has been taken. (See *Exhibit I*).
- c. A Fire Situation Report must be submitted daily to LZCC and a copy to the jurisdictional agency.
- d. Radio frequency authorization (See *Exhibit V*).

B. Coordination:

- a. The initial attack agency shall abide by the jurisdictional agency's procedures in dealing with ownerships involved.
- b. The initial attack agency shall submit its Fire Report to the jurisdictional agency within fourteen (14) days after the fire is declared out.
- c. The initial attack agency will continue dispatching services on fires for which initial attack actions are being taken.
- d. The agencies may jointly conduct mutual interest projects, within their authority, to maintain or improve the fire management capability of the agencies. Such projects will be conducted through specially developed agreements.

C. Payment:

The initial attack agency will bear the initial attack cost unless otherwise negotiated.

D. Critical Zone Needs:

The activation of a Multiple Agency Coordination (MAC) Group for extenuating fire needs of the Zone will be at the discretion of the MAC Group Board Members or delegates.

2. Escaped Initial Attack Fire

A. Communication:

- a. The initial attack agency shall notify LZCC when the fire has escaped initial attack.
- b. The time of escape, date, from whom and to whom the report is made must be documented by the dispatcher and reported immediately to the jurisdictional agency. (See *Exhibit III*).

B. Coordination:

- a. Jurisdictional agency will initiate management action as necessary to suppress the fire and assume management of the fire as soon as the designated agency representative arrives at the fire.
- b. The jurisdictional agency may request the initial attack agency to retain control of the fire. When agreement is reached, documentation will be made.
- c. The initial attack agency shall submit an estimate of reimbursable suppression cost to the State within two (2) weeks from the time the service was rendered (See *Exhibit IV*).
 - (1) Final bill will be submitted within one hundred-twenty (120) days from the time of the service.

VIII. **GENERAL PROVISIONS**

A. Fire Out Policy -

As a minimum, on an initial attack fire, a fire will not be abandoned until at least one (1) hour has passed since the last hot spot was check extinguished. A check of the fire will be made within twenty-four (24)

hours after it was abandoned to check for hot spots. If no hot spots are found, the fire will be declared out.

B. Mop Up/Abandonment Checks -

The initial attack agency will be responsible for mop up and abandonment checks, unless otherwise negotiated. Mop up and abandonment checks for escaped fires will be determined by the jurisdictional agency.

C. News Releases -

Involved agencies will coordinate news release items pertaining to the current fire situation to the media. Jurisdictional agency will be responsible for news releases on fire specific to their agency.

D. Fire Statistics (Fire Report/Records, etc.) -

The jurisdictional agency has the responsibility of preparing their statistical fire report. Information for this report shall be provided by the responding agency.

E. Effective Date -

This plan is effective when all parties have signed and dated.

F. Review/Revisions -

1. This Operating Plan will be reviewed annually by representatives of each participating agency before March 15th of each year. The plan shall remain valid for three to five years unless major changes in policy or direction render then plan invalid prior to the expiration of that period. The current plan should be revised prior to the 2007 fire season.
2. This Operating Plan will remain in effect among all the signing parties until one (1) or more of the parties submits a written Notice of Withdrawal from the Operating Plan which would affect the other parties signing. Interim modifications of this plan may be made subject to agreement by parties concerned to correct unworkable situations.
3. Changes in initial attack responsibility areas will be made as attachments to this Operating Plan and will be signed only by those parties involved in those changes. Amendments will be

submitted to the State Forestry Division to be placed in the Joint Powers Operating Plan master file.

4. Copies of the master Joint Powers Operating Plans and maps of initial attack zones will be maintained by the State Forestry Division.

Appendix F: Wildland and Prescribed Fire Monitoring Plan

Wildland and Prescribed Fire Monitoring Plan

Big Bend National Park

Submitted by: _____ Date _____
Fire Effects Module Supervisor

Reviewed by: _____ Date _____
Fire Management Officer

Approved by: _____ Date _____
Regional Fire Ecologist

Introduction:

Big Bend lies in the middle of the Chihuahuan Desert. More than ninety percent of the park is desert. High elevation canyons and bajadas of the mountains, ephemerally filled arroyos and depressions, expanses of lowland deserts, and permanent waters of the Rio Grande support 1200 plant species within the park. Diversity is further shaped by limestone and igneous soils, extremes in rainfall from 4 inches in the low desert to above 16 inches in the Chisos, and temperatures ranging from 100° F to freezing. Although precipitation is highly variable from year to year there are extended periods when the trend is increasing wet and periods when the trend is increasingly dry (Figure 1).

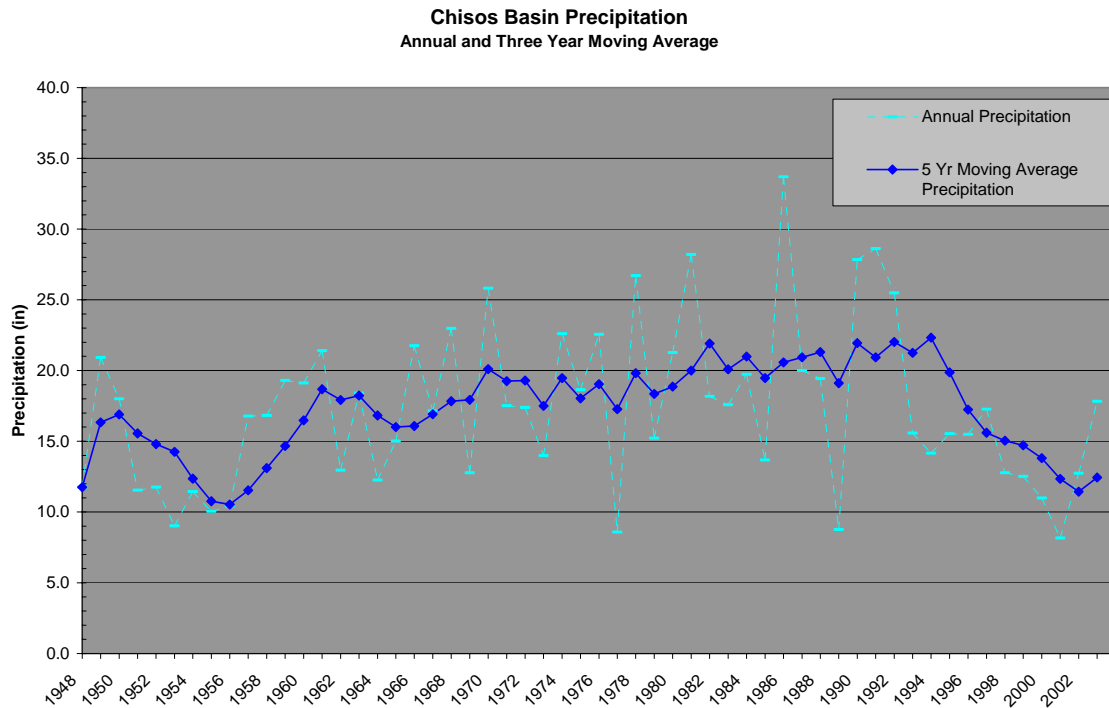


Figure 0-1 Three year moving average (solid line) of precipitation and annual precipitation (dashed line) for the Chisos Basin at Big Bend National Park, TX

The following paragraphs are brief descriptions of the vegetation categories:

Floodplain/Upland Riparian

Two cover-mapping categories, Mixed Riparian and Desert Willow from Plumb (1992) form this vegetation category. The Rio Grande with a high water table and dependable water all year round supports considerable stands of vegetation, and although just 3% of the park's area, this habitat forms a vital lifeline for animals and humans.

Common species: Big Bend cottonwood, honey mesquite, screwbean, willow, desert willow, acacia, common reed; exotics include saltcedar, giant reed, Bermuda grass and buffelgrass.

Scrub Desert:

This vegetation category was compiled from five cover-mapping categories from Plumb (1992); Creosote-Lechuguilla-Grass, Creosote-Lechuguilla-Prickly Pear, Creosote-Tarbush, Creosote-Yucca- Grass, and Lechuguilla-Candelillia-Hechtia. Desert scrub is dominated by shrubs (creosote, mariola and ocotillo) and succulents (prickly pear, lechuguilla, and Texas hetchia or false agave). Grasses are subdominant and provide insufficient fuels to carry fire. Scrub Desert occurs over half the park between the low-lying floodplains at 1,700 ft to mid-elevation desert grasslands at 3,000 ft. Average annual precipitation of 8-12 inches falls in winter and summer (mostly) with high rates of evaporation.

Common Species: Creosote, tarbush, lechuguilla, mariola, prickly pear, candelilla, hetchia, tobosa grass, sacaton, chino grama.

High Desert Grasslands:

This is the most diverse vegetation category in the park. High desert grasslands cover about 40 percent of the park ranging from 3,000 to 5,000 ft in elevation. Annual rainfall is 10-16 inches with most in summer. The grasslands contain some shrubs, low-growing trees and cacti.

Common Species: Lechuguilla, prickly-pear, bear-grass, sotol, viguiera, yucca, skeletonleaf golden-eye, ceniza, acacia, Dalea spp., grama grasses (Chino, blue, black, hairy and sideoats), tanglehead, lovegrass, California cottontop, green spangletop and threeawn, tobosa grass and alkali sacaton.

Shrub Woodland:

This vegetation category contains three cover-mapping categories from Plumb (1992). These are Mixed Scrub, Oak Scrub and Mixed Oak-Shrub Woodlands. This category includes many different shrub dominated communities scattered in the foothills and mountains of the Chisos Mountains and Dead Horse Mountains. Elevation is from 4,500 ft at Green Gulch to 5,500 ft near the Chisos Basin. Annual precipitation averages 12 to 16 inches.

Common species: Low growth Gray and Emory oak, catclaw acacia, catclaw mimosa, aloysia, slimleaf vauquelinia, Evergreen sumac, Shorthorn jefea, and low-growth redberry and alligator junipers.

Grassy Woodlands

Grassy Woodlands contain three cover-mapping categories from Plumb (1992). These are Pinyon- Juniper-Grass, Pinyon-Oak-Juniper, and Forest-Meadow. These categories are found approximately 5,500 ft to 7,200 ft with more than 16 inches annual rainfall.

Common species: Mexican pinyon, redberry juniper, weeping juniper, alligator juniper, gray oak, Graves and Emory oaks. Understory species of *Salvia* spp., Harvard agave, silk-tassel garrya, bull muhly, pinyon rice-grass.

Forest

The Forest category contains two cover-mapping categories from Plumb (1992). These are Pinyon-Talus and Oak-Ponderosa Pine-Cypress. Forest occurs above 6,000 ft with annual precipitation above 16 inches and forms a mosaic of conifers and grassy woodlands with various other species.

Common species: Mexican pinyon, Graves oak, redberry, weeping and alligator junipers.

Unique Habitats

Six habitats are determined as unique within the park. These are mountain meadows, Chisos grasslands, upland springs, limestone habitat, dunes, and Chisos woodlands and forest.

Management Objectives:

The fire ecology program at Big Bend National Park will tailor the fire effects monitoring program to provide pertinent information for adaptive fire management of vegetation. Research burns, by definition, will have a research component, that will include replicated treatments (a minimum of 3 treatment replications) that serve as either "controls" (untreated plots) and plots that receive the experimental treatment of prescribed fire, wildland fire use or mechanical thinning, herbicide application or some combination of treatments (i.e. burning + herbicide). Monitoring will also be conducted on fuels projects that are not designated as research to provide feedback as to whether or not natural, cultural or fire management objectives are being met and provide additional information to adaptively manage both wildland fire use and prescribed fire.

A reasonable attempt will be made to address each of the following Fire ecology research questions in each prescribed fire opportunity (1) effects of fire on plant community composition, (2) effects of fire on rare or sensitive plant and animal species, (3) soil movement in response to fire, (4) effects of fire on fuel loading, ladder fuels, and fuel size class distribution, and (5) forest stand age and size class structure.

Big Bend NP is divided into three fire management units, respectfully, FMU1, FMU2, and FMU3. A Fire Management Unit (FMU) identify an area of the Park that is assigned different fire management objectives and strategies based on management constraints, fire regime, and the human, natural, and cultural resource values to be protected. FMU 1, designated as the Suppression Unit, contains approximately 188,200 acres and includes developments, utility corridors, fire-susceptible cultural resource sites, legally protected species and habitat, private in-holdings and a variable-width suppression buffer along park boundaries. The strategy for managing fire in FMU #1 is to suppress all fires using methods necessary to confine, contain, or control. FMU #2, the Wildland Fire Use Unit, is that portion of the park lands that **does not** include developments, utility corridors, fire-susceptible cultural resource sites, legally protected species and habitat, private in-holdings and a variable-width suppression buffer along park boundaries. FMU 3 is the Chisos Mountains. The Chisos Mountains, designated as a Special Treatment Unit contains approximately 39,000 acres. Wildland Use Fires may be allowed within prescription depending on site, or suppressed until research results indicate likely outcomes. These proposed research fires are aimed at supporting science-based management in the park. Fire effects will be monitored with respect to sensitive species and habitats, at differing intensities, and in different seasons.

Monitoring Design:

National Park Service Wildland Fire Management policy (NPS 1998) directs managers to monitor all prescribed and wildland fires. Fire effects monitoring must be done to evaluate the degree to which objectives are accomplished. Long-term monitoring is required to document that overall programmatic objectives are being met and undesired effects are not occurring. Evaluation of fire effects data are the joint responsibility of fire management and natural resource management personnel.

Monitoring plots are planned for all six vegetation categories to establish baseline information on species, vegetation structure, cover and height. These plots augment research begun in the late 1970s and early 1980s to develop databases that indicate fire effects over the long-term. The need for a research and monitoring program was noted in the 1994 FMP (p. 80-81). Post-burn information allows comparisons with earlier surveys, refinement of current prescriptions, and eventually may provide information for prescriptive fire plans. Post -fire monitoring is proposed for prescribed burns where such data will assist park resource objectives.

Fire monitoring within Big Bend National Park follows the recommended standards described in the Fire Monitoring Handbook (NPS 2003). These standards are based on four levels of monitoring:

- **Level 1: Environmental.** This level provides a basic overview of the baseline data that can be collected prior to a burn event. Information at this level includes historical data such as weather, socio-political factors, terrain, and other factors useful in a fire management program. Some of these data are collected infrequently (e.g., terrain); other data (e.g., weather) are collected regularly.
- **Level 2: Fire Observation Documentation.** Monitoring fire conditions calls for data to be collected on ambient conditions as well as on fire and smoke characteristics. These data are coupled with information gathered during environmental monitoring to predict fire behavior and identify potential problems.
- **Level 3: Short-term Change Monitoring.** Short-term change (level 3) is required for all prescribed fires. Monitoring at this level provides information on fuel reduction and vegetative change within a specific vegetation and fuel complex (monitoring type), as well as on other variables, according to your management objectives. These data allow you to make a quantitative evaluation of whether a stated management objective was met. Vegetation and fuels monitoring data are collected primarily through sampling of

permanent monitoring plots. Monitoring is carried out at varying frequencies— pre-burn, during the burn, and immediately post-burn; this continues for up to two years post-burn.

- Level 4: Long-term Change. Long-term change (level 4) monitoring is also required for prescribed fires, and often includes monitoring of short-term change (level 3) variables sampled at the same permanent monitoring plots over a longer period. This level of monitoring is also concerned with identification of significant trends that can guide management decisions. Some trends may be useful even if they do not have a high level of certainty. Monitoring frequency is based on a sequence of sampling at some defined interval (often after five, then ten years, then every ten years) past the year-two postburn monitoring. This long-term change monitoring continues until the area is again treated with fire.

At Big Bend National Park environmental monitoring (level 1) is required for all fire management activities and most of this monitoring is on-going and not tied to a specific fire incident. Environmental monitoring provides the basic background information needed for decision-making. The following types of environmental data are collected: weather, fire danger rating, fuel conditions, and values to be protected. Data collection related to weather, fire danger rating, and fuel conditions has already been described in this document. Data specific to values to be protected is collected opportunistically. As cultural resources, rare or endangered species, or research plots are located, that information is shared with the Big Bend National Park Fire Management Program. If fire or fire suppression poses a risk, strategies are developed to mitigate that risk.

At Big Bend National Park, fire observation monitoring (level 2) is required for both fire suppression and wildland fire use. Fire suppression requires only reconnaissance monitoring while wildland fire use requires both reconnaissance and fire condition monitoring. Reconnaissance monitoring includes the following variables: fire cause (origin) and ignition point, fire location and size, logistical information, fuels and vegetation description, current and predicted fire behavior, potential for further spread, current and forecasted weather, resource or safety threats and constraints, smoke volume and movement. Fire condition monitoring includes the following variables: topography, ambient conditions, fuel model, fire characteristics, smoke characteristics, holding options, and resource advisor concerns. Post-burn reports will be prepared by the resource advisor where assigned for their specialties. Other aspect of the report may be filled in by applicable fire staff.

Level 3 and level 4 monitoring, Long and Short Term Change, are done in compliance with Fire Monitoring Handbook (NPS 2003) at Big Bend NP, TX. Special data needs may use other techniques that those found in the FMH handbook.

In summary, Level 3 & 4 monitoring involves the establishment of transects to measure changes in plant communities. These are randomly placed through out prescribed burn units. The plots are marked with metal stakes and tags. A point transect is used to obtain percent cover and community structure for grasses and herbs. A belt transect is used to determine densities in brush species. Plots in FMU 3 also involved the census of tree species to determine densities. Common to all plots are the photographic points to record and document current conditions. Although these techniques are geared to prescribed burning, they are easily adapted to use in the monitoring of non- fire treatments.

Monitoring Implementation Schedule

A schedule for the measurement of plant monitor plots is found in Appendix A.

Data Management and Analysis

All data is stored electronically in two separate places. These are Dell latitude laptop computer and a desk model Dell OPTIPLEX GX270 located in the FMO. In addition back up disks of all data will be made. Hard copies of the original field forms are maintained and stored in a file cabinet located at the FMO.

Analysis of data is done through the use of the Fire Ecology Assessment Tool (FEAT). The use of the original FMH program may be used until all data is transferred to FEAT. Other statistical packages, such as StatView, S Tabor Mini- Tab, may be used. Analysis on the data is presently being done on request.

Roles and Responsibilities

The following is a brief recapitulation of the statements found in both the BIBE draft FMP and RM- 18.

Fire Management Officer: The Fire Management Officer reports directly to the Chief Ranger of Big Bend National Park. Minimum fire line qualifications for the Fire Management Officer are found in *Interagency Fire Program Management Qualifications Standards and Guide August 2001*.

The Fire Management Officer is responsible for all wildland fire operations, including the following:

- Directly supervises and coordinates the prevention, preparedness, management/ suppression of fire programs within the Park.
- Develops and updates park fire management plans, including annual appendix updates.
- Monitors fire danger and recommends fire restrictions in concert with neighboring agencies
- Prepares the fire program budget and coordinates/manages all fire funding and accounts.
- Serves as the lead Interagency Wildfire Contact for the Park, maintaining frequent communication with other units of the Southwest Texas Fire Planning Unit as well as state partners.
- Coordinates Park activities with regional fire staff.
- Directly supervises program lead fire staff.
- Approves DI-1202s for all support actions and fires inside the park. Ensures reports are entered into national database.
- Initiates taskbooks for wildland fire positions, certifies completion.

Fire Ecologist, Chihuahuan Desert Parks: Supervises the Fire Effects Module and in coordination with the FMO, is responsible for the periodic review and revision of the Park's Fire Management Plan.

- Assess monitoring reports in relation to project and resource goals and objectives.
- Proposes and secures funding for fire ecology research.
- Develops rehabilitation plans required following suppression actions.
- Serves as the Park's Resource Advisor to the Incident Commander or Incident Team.
- Leads development of monitoring types, including presence/density of non-native plants.
- Facilitates development of multi-year burn plans, to include second or third treatments.

Fire Effects Module Supervisor

- Writes and updates fire monitoring appendix to park fire management plan
- Ensures fire effects monitoring plots are established according to protocols.
- Analyzes data collected from plots and reports findings to parks on an annual basis.
- Makes assessments of effectiveness of fire in accomplishing vegetation objectives.
- Reviews prescribed fire and fuel project plans for objectives and monitoring plans.
- Serves as acting FMO according to skills and abilities.

- Leads live fuel moisture monitoring program and provides information to interested parties.
- Provides input into ten year treatment plan and monitoring type descriptions.
- Serves as Duty Officer during fire season.

Chief, Division of Visitor and Resource Protection: The Chief Ranger directly supervises the Fire Management Officer. Directs and coordinates support activities between the FMO and District Rangers.

- Contribute to protection-based fire management program objectives.
- Monitor effectiveness of wildland fire management plan implementation.
- Assist wildland fire program with needs for fire investigation and enforcement.
- Ensure effectiveness of park dispatch operation in meeting fire operation needs.
- Participate on Wildland Fire Analysis Team as needed. Provide input to WFIP and WFSA.
- Review and implement fire restrictions, trail and area closures, and evacuations.
- Review fire management plan updates and prescribed fire burn plans.
- Ensure coordination and training of field rangers in fire readiness and initial response.

(i)Chief, Division of Resource Management and Research

- Contribute to resource-based fire management program objectives.
- Support development of multi-year treatment plans and individual project plans.
- Manage and coordinate NEPA/106 compliance, and accomplish compliance as needed.
- Ensure division personnel participate in fire operations to understand fire use and effects.
- Support development of fire effects monitoring types appropriate to park vegetation.
- Support integrated GIS-based risk analysis models such as FARSITE.
- Participate on Wildland Fire Analysis Team as needed. Provide input to WFIP and WFSA.
- Make resource advisors and specialists available to incident/project teams as needed.
- Through park botanist, compile fire effects information for non-native plants and review proposed treatment areas for infestations, and need to re-seed with local native grasses.

Superintendent:

- Ensures safe implementation of wildland fire management program at Big Bend.
- Ensures program supports Service-wide initiatives.
- Approves wildland fire management plan and updates, interagency agreements and operating plans, delegations of authority, prescribed fire

- plans, and management of wildland fire use incidents, through daily updates of WFIP or WFSA.
- Ensure wildland fire management program is appropriately planned, integrated with other programs, and adequately supported by other park operations.
 - Approve wildland fire management updates, interagency agreements and operating plans, delegations of authority, and prescribed fire plans in absence of Superintendent.
 - Participate on Wildland Fire Analysis Team as needed. Provide input to WFIP and WFSA.
 - Ensure an agency representative is assigned to Type 1 and 2 incident commanders.

Regional Fire Ecologist: The Regional Fire Ecologist coordinates monitoring and research needs on a regional level.

- Also s/he provides technical and ecological expertise to fuels, BAER, and other pertinent projects.
- The RFE approves park monitor plans.

Regional Director, Intermountain Region: Authority for the approval of the environmental compliance document for this Fire Management Plan rests with the Regional Director of the Intermountain Region, National Park Service. This position is base-funded by the Intermountain Region and is not a fire-funded position.

Regional Director, Intermountain Region: Authority for the approval of the environmental compliance document for this Fire Management Plan rests with the Regional Director of the Intermountain Region.

Reports and Documentation

Annual Reports

Annual park reports of the activities for the BIBE fire effects group will be prepared to summarize and document the activities. It should include the number of plots established along with the number of rereads. The establishment of non FMH plot is included. Other information to garner for the report: plant survey, training, number of pay periods worked, data analyses done and fire effect noted in projects.

A second annual report is submitted to the regional office. It includes much the same information as the park report.

Other Reports

Special report will be prepared as data needs or questions arise. These will be fluid to accomplish the needs of the inquirer. A copy of all reports will be kept on file.

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Bourgeron P.C., H.C. Humphries, and M.E. Jensen. 1994. *General Sampling Design Considerations for Landscape Evaluation in Jensen, M.E.; Bourgeron, P.S., tech. eds. 1994. Volume II: Ecosystem management: principles and applications. Gen. Tech. Rep. PNW-GTR-318. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 376 p. (Everett, Richard L., assessment team leader; Eastside forest ecosystem health assessment).*

NPS. 2003. *Fire Monitoring Handbook*. Boise (ID): Fire Management Program Center, National Interagency Fire Center. 274 p.

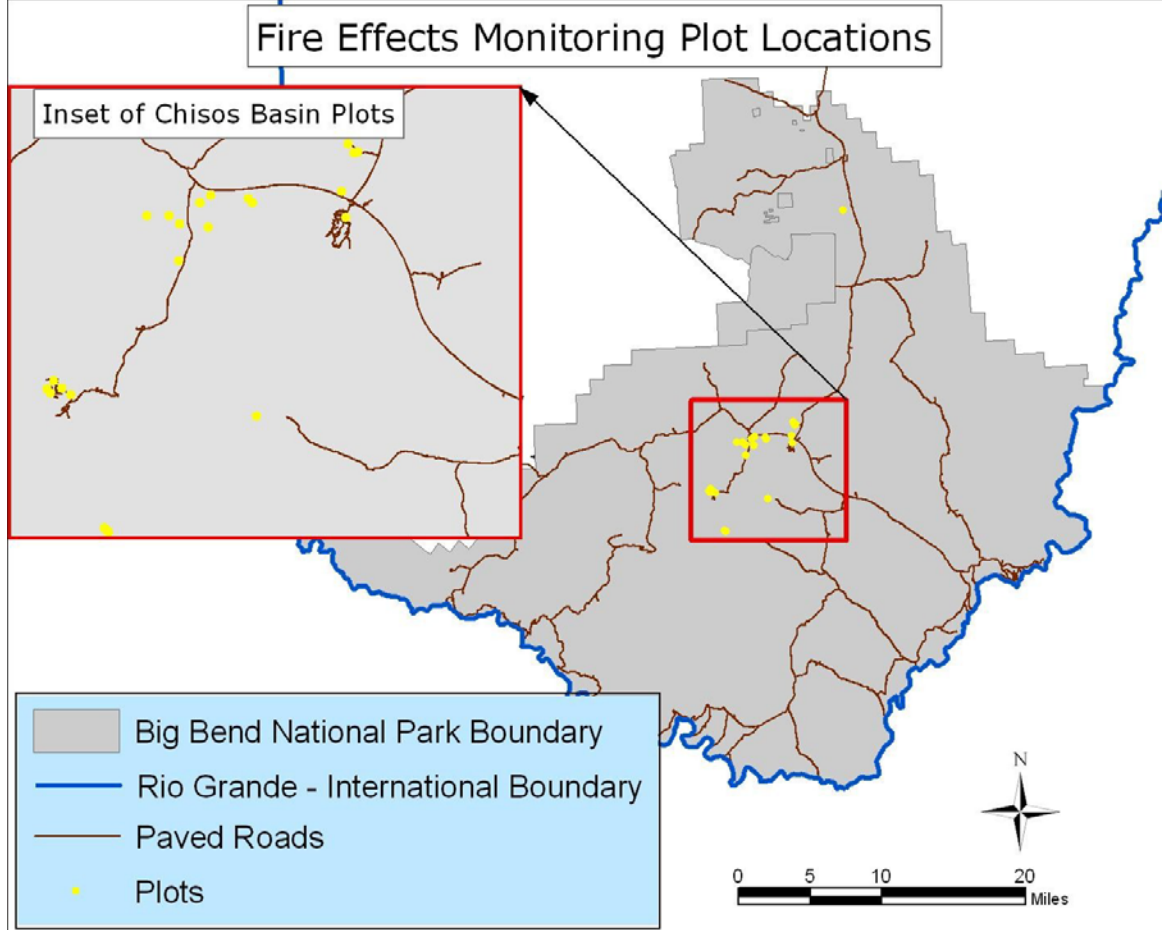
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Appendices

A. Monitoring Schedule

BURN UNIT	MONITORING TYPE	PLOT NUMBERS	PRE	BURN DATE	<6 MO.	1 YEAR	2 YEAR	5 YEAR	10 YEAR
PJ Blocks E & F	BAGLE1D02	1	Jul. 97	Jul. 97	Sep. 97	Sep. 98	Jun. 99	2002	2007
Basin Block E	9701	1	Jun. 97	Sep. 97	Oct. 97	Oct. 98	Jun. 99	2002	2007
Basin Block F	BALGR1D05	2	Sep. 98						
Basin Block D	BALGR1D05	3	Aug. 98						
Basin Block K	BALGR1D05	4	Aug. 98						
Basin Block K	BALGR1D05	5	Oct. 98						
Basin Block N	BALGR1D05	6	Sep. 98						
Comanche Draw	BPRGL1D05	1	Jul. 00						
Junction	BDALE1D02	1,2	Jul. 98	May-99	Jun. 99	Jul. 00	Sep. 01	2004	2009
Junction	BAGLE1D02	5,8	Jul. 98						
Junction	BAGLE1D02	10	Aug. 98						
Lone Mountain	BAGLE1D02	2	May-98	Apr. 99	Apr. 99	Jul. 00	Aug. 01	2004	2009
Lone Mountain	BAGLE1D02	4	May-98	Apr. 99	1999	2000	2001	2004	2009
Lone Mountain	BAGLE1D02	11	Sep. 98	Apr. 99	Apr. 99	Jul. 00	Aug. 01	2004	2009
Lone Mountain	BDALE1D02	4,5	Sep. 98	Apr. 99	Apr. 99	Jul. 00	Aug. 01	2004	2009
Pine Canyon	BDALE1D02	6	Sep. 98						
Powerline	BDALE1D02	3	Jul. 98						
Powerline	BAGLE1D02	9	Jul. 98						
Rough Springs	BAGLE1D02	6,7	Jul. 98						
South Rim	FHIGH1D10	1	Sep. 98						
South Rim	FHIGH1G10	2,3,4,5,6,7	Jul. 99						
South Rim	FHIGH1G10	8,9,10	Aug. 99						

B: Plot Location Maps



Appendix G: PRE-ATTACK PLAN

Big Bend National Park Pre Attack Plan

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Reference the Big Bend National Park Fire Management for the following documents: PlanPre-Attack WFSA, Draft Delegation of Authority, Management Constraints Interagency Agreements, and Pre Positioning Needs(Step-up Plan).

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COMMAND

Evacuation Procedures

CHISOS BASIN WILDFIRE EVACUATION PLAN

The Chisos Basin developed area has the potential for a catastrophic wildfire endangering lives and property. With the safeguarding of human life as our primary objective, the evacuation of visitors, employees, and residents in the Basin area to a safe zone will be initiated when a wildfire has the potential to create a life threatening situation in the judgment of the park Superintendent, Chief Park Ranger, or an incident commander in charge of a wildfire in the Basin area. The West District Ranger or their designee will be responsible for managing the evacuation effort. **When implemented, the evacuation effort will take priority over wildfire suppression and structure/property protection.**

Any fire with the recognized capacity to spread into the Basin developed area and/or cut off the evacuation route will cause this Evacuation Plan to be implemented, such as:

- A fire originating at or below the upper Basin; or
- A fire in close proximity to the Basin entrance/exit road.

EVACUATION OPTIONS

The preferred evacuation from the Basin will be **out Route 14** (the Basin Road), utilizing the outbound lane only. Depending on the occurrence of smoke or other hazards, an escort by a marked patrol unit may be needed. Depending on the number of visitors to be evacuated, visitors should be directed to wait in either Panther Junction Visitor Center parking area, K-Bar area, Hannold Draw area, or RGV, until contacted for return instructions. A NPS representative will be assigned to manage and provide information at the chosen area(s).

or

In the event the evacuation route is obstructed to vehicular travel, or there is not enough lead time to evacuate all persons from the Basin, the evacuation will be to **safe areas within the Basin Safety Zone** (see attached maps) located in the Basin developed area. A NPS representative will be assigned to manage and provide information at the safety zones.

NOTIFICATION PROCEDURES

- Dispatch will contact all members of the Wildland Fire Crew and Structural Fire Brigade.
- Upon receiving a report of fire in proximity to the Basin, Dispatch will alert the Fire Management Office, Chief Park Ranger, and the West District Ranger.

ACTIONS TO BE CONSIDERED IF SIZE-UP INDICATES A THREAT TO LIFE AND PROPERTY:

- Expanded dispatch should be initiated.
- Traffic control will be the next priority to insure emergency vehicle access to the Basin is maintained and evacuation efforts, if needed, are safe and orderly. Protection employees with emergency vehicles should be deployed at the following intersections/locations unless otherwise directed by the IC:
 1. Junction of Routes 13 and 14, to prevent visitor traffic flow into the Basin.
 2. Intersection of Basin Road and campground access road, to direct evacuation traffic.
 3. Basin developed area to assist traffic control out of the Basin, or parking and staging of persons in the safety zone. A safety zone has been identified for staging of persons in the Basin (see attached map).
 4. Lost Mine Trail parking area to ensure vehicles do not hinder emergency access/egress.
- The Basin concessionaire **manager** or his/her designee will be alerted of the fire and to prepare their staff for a possible need to evacuate. **Visitors should not be notified by the concessionaire until specifically directed to do so.** If so directed by a NPS authority, a designated person from the concessionaire will initiate evacuation of lodge/motel/stone cottage guests and employees. The concessionaire will maintain approved procedures to assure that all persons within their assigned areas are notified and instructed what to do. Once the initial notification is completed, a follow-up check by the concessionaire will be done to assure

that all have safely followed instructions. A checklist of people contacted/evacuated will be maintained, if time permits.

- All available employees (and Border Patrol, Sheriff's Office, if available) will be made available and utilized as needed in the evacuation and suppression efforts. **Park functions may be shut down to support the evacuation effort.** Personnel not responding to the suppression efforts should stage at the Panther Junction Emergency Services Building (ESB) to receive a briefing and assignments. A person will be assigned to coordinate/direct the resources at the ESB.
- Two employees will be designated to proceed to the Basin family and group campgrounds to direct visitors on evacuation procedures.
- A designated NPS person and concessionaire representative will notify residents and assure evacuation of the residential area/remuda.
- If Route 14 is open and being used as an evacuation route, a park employee will notify visitors and assure evacuation of the Chisos Basin visitor center and parking lot area.
- Visitors on the Lost Mine, Window, Laguna Meadows, Pinnacles, Basin Loop, Window View, and Oak Spring Trails may be contacted depending on fire behavior and lead time available, and notified of the quickest/safest escape route out of the Chisos Mountains, or to the nearest safety zone.
- Extreme caution will be exercised in sending any foot patrol into the High Chisos if a fire is reported in the Basin.
- Depending on all factors (including lead time), the park plane may be dispatched to assist with fire reconnaissance or message drops for the purpose of contacting backcountry users.
- Rotary wing aircraft may be needed if evacuation of the Chisos backcountry is imminent. U.S. Border Patrol, Customs, or Lincoln Zone aviation resources may be available.

- Medic One and, if needed, the Terlingua Medics should be made available to respond to the Basin developed area as needed.
- Designated persons, as available, to assist/instruct visitors exiting the Chisos Mountains via Blue Creek, Juniper Canyon, and Pine Canyon (if needed).
- A checklist of people contacted/evacuated will be maintained, if time permits.

BASIN SAFETY ZONE

- In the event the evacuation route is obstructed to vehicular travel, or there is not enough lead time to evacuate all persons from the Basin, a "Safety Zone" will be established in the Upper Basin area consisting of the upper developed area of the Basin: Visitor Center, motel units, lodge, camper store, and all associated parking areas (see attached map).
- The concessionaire has 72 associated lodging units accounting for approximately 150-200 persons. The Basin Campgrounds when full would add approximately 200-250 people. An estimate of persons being in or around the Basin, including day-use plus employees, is 400-450 during the busy periods.
- "Safety zones" will be used to house visitors during the immediate threat of an advancing wildland fire in the Basin. The following are "safety zones" to be used: concessionaire lodge, Basin visitor center, camper store, motel units, large parking lot in center of developed area, and amphitheater parking lot. Number of parking spaces available is approximately:

Lodge/Restaurant: 45

Rooms/VC: 150 (Includes spots behind old motel units)

Amphitheater: 50

Lost Mine: 15 plus oversize vehicle parking

- Vehicle traffic will be limited. Parking for incoming visitors already in the basin will be behind the Lodge, behind the single story motel units, and the amphitheater parking area. Efforts will be made to keep the main lot accessible for movement of emergency vehicles. Access to the fire bay and fire hydrants must be maintained. To maximize safety zone space, campers should not be permitted to drive their vehicles from campsites. Campers and residents should be directed to walk to the nearest safety zone.
- Fire protection will be provided by trained personnel with the existing fire hydrants, pumpers, and structural engines.
- To ensure adequate water supply for critical life protection, the concessionaire may be requested to shut down water distribution systems within their facilities.

PREPAREDNESS

The West District Ranger will conduct a walk-through drill with the concessionaire and key park staff annually to insure preparedness. The Management Assistant will insure the concessionaire has a current, approved evacuation plan in accordance with this Plan.

High Chisos Backcountry Campsite Evacuation Plan (THIS IS A DRAFT PLAN)

The High Chisos Backcountry Campsite Evacuation Plan will pre-plan for the evacuation of the High Chisos campsites. Fuel loadings, extreme terrain, isolated nature of the campsites and the inability of park management to contact visitors during wildfire events necessitate the formation of this plan to protect human life. This plan intends to address concrete steps that will be taken in order to facilitate evacuation. It is also recognized that environments on the fire ground are extremely dynamic and changes to this plan may need to be made to this plan at any time to ensure firefighter and public safety needs are met at all times.

COMMUNICATION TO VISITORS THE RISK OF WILDFIRE AND NEED FOR POSSIBLE EVACUATION

These steps will serve to educate the visitor about the risk of wildfire in the High Chisos. It will also give visitors the opportunity to pre-plan evacuation routes and ask questions of park staff before visiting the backcountry campsites.

Dec. '04/Jan '05

Big Bend NP Dispatch began posting Daily Fire Danger Rating for the Park on the Daily Report. This Report is broadcasted over park radio frequencies, informing employees involved in emergency operation of the Fire Danger for the day. The Daily Report is also posted at all visitor centers inside the park and outside the park at cooperating businesses and Texas State park facilities.

These postings will serve as notification to park visitors and cooperators of the current fire danger level.

Spring '05—

Visitor centers will post High Chisos campsite evacuation information at visitor centers and bulletin boards informing visitors of necessary precautions while hiking in this isolated area.

Interpretation and Visitor Services will begin attaching an Evacuation Card to each High Chisos backcountry campsite permit during periods of High, Very High, and Extreme Fire Danger in the Chisos Mountains. This card will

educate the visitor of what actions to take to facilitate evacuation. The Fire Danger Rating for the Chisos Mountains is available from the USFS R3 Wildland fire Website. This information is compiled from weather readings from the Fire Weather Station in the Chisos Basin Developed area.

DURING WILDLAND FIRE EVENTS

One individual will need to be placed in charge of Chisos Backcountry evacuation. An ICS unit log will need to be kept by this individual to document actions taken.

Upon verification of a wildland fire in the Chisos Mountains that may be dangerous to visitors it will be necessary to notify all visitor centers of a closure of the High Chisos Backcountry campsites. Closure signs will need to be posted at all trail heads leading into the high Chisos as soon as possible.

It will be necessary to compile a list of all active backcountry permits in the High Chisos. From that list critical information will need to be extracted from the permit (i.e. Name of permittee, # of persons in party, vehicle information, where their campsite was when the fire was reported.)

Once extracted this information will show the # of individuals that need to be accounted for to ensure that public safety needs in the High Chisos have been met and the area is secure.

It will be made known to all personnel involved with the incident that information will have to be relayed to dispatch to document visitors from the High Chisos have been accounted for and their current status .

Provisions will be made to track and document any day hikers that are know to be in the high country during a wildland fire. (Day Hiker Trail log system establishment?)

If possible an EMS team will need to be activated to provide care for the public and incident personnel.

Once all public has been accounted for (permittees and day hikers) the High Chisos will be declared secure from all non-incident personnel.

OTHER CONSIDERATIONS

If arson is suspected any individual with a backcountry permit or anyone in their party will be interviewed by Law enforcement to gather pertinent facts related to the wildland fire.

Trail crew may be working in the High Chisos. They may be a good resource to assist with backcountry evacuation.

Only certified wildland firefighters should be used to carry out foot patrols in the areas near the wildland fire.

Foot patrols or other personnel inserted via helicopters for evacuation will need to evaluate safety at all times. 10 Standard Fire Orders and the 18 Watch out situations will be adhered to at all times.

Visitors that stayed in the backcountry and were evacuated will be a good source on information on how smoothly the evacuation took place. They will be a good source of information to help improve procedures related to this plan.

Structural Protections Needs

A structural assessment of all structures in the Basin Developed Area and Panther Junction Housing and Headquarters is underway. Once the risk to Wildland fire is completed it will be placed in this binder to help facilitate structure protection in a wildland fire incident.

Engines 811 and 812 (both Type I Structure Engines in the Park) have Structure Pre-Plan Binders to assist in Structure fire Incidents.

Closure Procedures

The following is reproduced from RM-18 Chapter 7 Exhibit 4. Version 2.0

January 24, 2005

GUIDELINE FOR DETERMINING NEED FOR PARK CLOSURE/EVACUATIONS

The following questions are presented as a guideline to assist park fire managers in determining the present or predicted necessity for evacuation of all or part of the park. The superintendent will make the final decision for closure/evacuation. Because of the critical time elements involved in closure and evacuation, this checklist should be completed at any time two or more elements in primary factor A are positive and should be kept as part of the park's fire records. This analysis should be based on predictions to allow adequate time for implementing the appropriate action.

For purpose of this guideline, key terms are defined as follows:

1. Partial closure: Park closure to visitors in specified areas.
2. Full closure: Park closure to visitors at entrances.
3. Evacuation: Removal of employees' families and/or visitors from the park.

The following steps are to be taken to make determinations:

1. Analyze each element and check the response "yes" or "no."
2. If positive responses equal or exceed negative responses within primary factors A through D; the primary factor should be considered a positive response.
3. Primary factor E is considered as a separate determinant.
4. Employ the following criteria to determine action:

- a. If factor E is "no" and one other primary factor is "yes," consider full or partial closure.
- b. If factor E is "no" and two or more primary factors are "yes," consider partial or full closure and evacuation of visitors.
- c. If factor E is "no" and three or more primary factors are "yes," consider evacuation of visitors and employees' families.
- d. If factor E is "yes," evacuate visitors and employees' families regardless of responses to other primary factors.

A. FIRE BEHAVIOR (observed or predicted)

YES NO

1. Burning Index, Fuel Model L, 54 or above (VH to EX).
2. Crowning or spotting observed.
3. Rate of spread 80 chains (1 mile) per hour or greater.
4. Fire Size: 300 acres or more
5. More than two Class C size fires (>10 acres) burning concurrently.

TOTAL

B. PERSONNEL COMMITTED PARKWIDE

YES NO

1. Unusual initial attack forces committed.
2. Park cooperative agreement crews committed.
3. Park incidental firefighters committed.
4. Fires remaining unstaffed after commitment of above park forces.
5. Relief forces more than two hours away.

TOTAL

C. OPERATIONS

YES NO

1. Access/egress route likely to be heavily used by suppression traffic.
2. Extensive air operations in vicinity of developed areas.
3. Potential incident base location in area which conflicts with routine visitor activities.

TOTAL

D. LOCATION AND DIRECTION OF SPREAD

YES NO

1. Fire north of developed areas, proceeding south.
2. Fire south of developed areas, proceeding north.

TOTAL

E. EXIT

YES NO * Any vehicular egress route directly threatened for extended period (i.e., to point where no traffic could safely get through).

Logistical Considerations

Incident Command Post and Base Camp Locations

Many possibilities exist with different levels of services and different sizes. Depending on the size of the incident and its corresponding needs a combination of these sites could be used. Other possibilities may exist that are not listed here.

Locations with Water and minimal Electricity:

Chisos Basin Campground (60 sites with 24 ft limit vehicle size)

Chisos Basin Group Campground (7 sites for 104 people)

Cottonwood Campground (32 sites, pit toilets, limited water, no electricity)

Cottonwood Group Campsite (25 persons)

RGV Main Campground (100 sites)

RGV Group Campground (4 sites for 120 persons)

RGV RV Site (25 full hook ups)

RGV Overflow areas (400 + persons, limited water, primitive).

K-Bar Gravel Area just north and east of Ranch house (150' X 350')

San Vicente ISD School grounds, offices, classrooms and gym at Panther Junction.

San Vicente ISD Baseball Diamond and Playground area (350' X 300')

Primitive Sites. No water or electricity available. With Resources approval, some of these sites may be able to be improved and enlarged with a road grader, front end loader or other heavy equipment.

--RT. 12 Mile 5 Borrow Pit (100 feet X 150 feet)

--Dagger Flats Borrow Pit. ½ mile east on Dagger Flats Rd; south side. (150' X 350')

--RT. 11 just before mile 8 on west side of road.

(750' X 350')

--Hannold Draw campsite and Borrow Pit.(780' X 150')

Roads, Trails and Logistical Considerations

Trails Illustrated topographic maps are available at all Visitor Centers. A full set of topographical maps (1:24,000 scale) is available in Park Dispatch. These maps will show most roads and trails that can offer access to fires for logistical support. Other information on historic roads and powerline access roads can be accessed in Resource Management. On the Dispatch computer Terrain Navigator software is installed to provide computerized topographic maps for easy access, printing and distribution. On the FMO and Supervisory Forestry Technician computers Terrain Navigator is also available to access road and trail information for logistical support of fires.

Limitations to vehicle size and capability on backcountry roads are present. Precipitation will play a large part in how passable the backcountry roads are. 4X4 Type 6 and 5 engines will not have any problems on any backcountry roads unless it has rained recently. Due to the dynamic nature of the backcountry roads specific conditions will not be mentioned here. The latest information will be available through park dispatch and the Incident Commander of the incident.

General Medical Services

PARK'S MEDICAL CONTROL IS DOCTOR DAVE SPEAR:

PO BOX 13831, ODESSA 79768

PAGER.....(432)499-6638

HOME.....(432)381-0203

MEDICAL CENTER ODESSA..... 1-888-624-3571

FAX..... (432)385-1665

ALPINE

IF OUR MEDICAL CONTROL IS NOT AVAILABLE CALL THE BBRMC IN **ALPINE**. IDENTIFY YOURSELF AND EXPLAIN YOUR MEDICAL SITUATION (**MAKE SURE YOU ARE TALKING WITH A P.A. OR AT LEAST AN R.N. AND WRITE DOWN THEIR NAME ON YOUR RADIO LOG**).

BIG BEND REGIONAL MEDICAL CENTER. (432) 837-3447
EMERGENCY ROOM (432) 837-0209

LAJITAS CLINIC 9-1pm, and 2-5pm Wed-Fri
(lab work, ekgs, some meds, x-rays)
(432) 424-5111 *or* (432) 424-5112
After hours and weekends (432) 424-5000
PA John Alexander (can call with questions or evaluation) HOME (EMERGENCIES ONLY).424-3343

MARATHON RURAL HEALTH CLINIC 8:30am-noon, 1-5:30p Mon & Thur
(432) 386-4316

FT. STOCKTON

PECOS COUNTY MEMORIAL HOSPITAL.(432) 336-7515

MIDLAND/ODESSA

MIDLAND MEMORIAL HOSPITAL. (432) 685-1111
ODESSA MEDICAL CENTER (432) 640-1190

SAN ANTONIO

BROOK ARMY HOSPITAL. (210) 916-4141
BURN UNIT (DIRECT LINE). (210) 916-2720

DALLAS

PARKLAND HOSPITAL. (214) 590-8000
BURN UNIT (DIRECT LINE). (214) 590-5524

EL PASO

THOMASON HOSPITAL. (915) 544-1200
WILLIAM BEAUMONT - FT. BLISS.(915) 569-2121
569-2333 (EMERGENCY)
PROVIDENCE MEMORIAL HOSPITAL.(915) 577-6011
577-6551 (EMERGENCY)

AMBULANCE SERVICE
TERLINGUA MEDICS

Business Only. (432) 371-2536
Emergency Only. (432) 371-2222
FAX. (432) 371-2546

ALPINE

MIKE SCUDDER (THROUGH ALPINE PD) (432) 837-3486
HOME.(432) 837-7471

FT. STOCKTON (VOLUNTEER).(432) 336-4600
. OR **911**

MARATHON (VOLUNTEER) (THROUGH ALPINE PD) (432) 837-3486
..... BUSINESS (432) 386-4517
..... HOME (432) 386-4508

MARFA (432) 729-3151
SHERIFF'S OFFICE- AFTER HOURS (432) 729-4308

POISON CONTROL CENTER

GALVESTON (Main Number) 1-800-392-8548
ODESSA 432-333-1231
..... (800) 764-7661

TEXAS DEPT OF HEALTH

PRESIDIO(432) 229-3481 OR 229-3236
ALPINE(432) 837-3877

POLICE PSYCHIATRIST (COUNSELING IF A FATALITY)

Rick Bradstreet - Austin Police Dept.(512) 974-5000
Kevin Gilmartin - Tucson, AZ (retired).(520) 322-5600
Police Psychologist for Houston P.D. (713) 222-2555

Medical Air Transport Resource Information

Midland Center Hospital, Odessa TX 1 888 624 3571

Life Flight A-Star Helicopter

Shannon Medical Center Life Flight
San Angelo, TX
(2HR ONE WAY TRAVEL TIME)

1-800-277-4354

Lifeguard Air Ambulance Services
Ft. Worth, TX

1-800-248-5437

Aero Care
Lubbock, TX

1-800-248-5437
1-800-744-5055

MILITARY ASSISTANCE TO TRAFFIC
Ft. Bliss, TX (EL PASO)

(915) 568-8834 (EMERGENCY #)
(915) 568-8833 (EMERGENCY #)
(915) 568-8128 (OPS QUESTIONS)

Federal Cooperator Air Craft
U.S. Border Patrol

AIR OPERATIONS
P.O. DRAWER I
MARFA, TEXAS 79843

729-3313 (AIR OPS OFFICE)
729-4353 (DISPATCH)

CHIEF: J.W. CLIFFORD

729-4707 (HOME)

TYPE OF SERVICE/AIRCRAFT/STAFFING

HUGHES 500 (C OR D)

DEL RIO, TEXAS
2 HOUR RESPONSE TIME

210/774-1705

U.S. Customs

SAN ANGELO/SAN ANTONIO
P.O. BOX 62390
SAN ANGELO, TEXAS 76906

432 /942-6800 (24 HOUR)

BRANCH CHIEF: ROBERT VIATOR

TYPE OF SERVICE/AIRCRAFT/STAFFING

CITATION, BLACKHAWK

ALBUQUERQUE/EL PASO
P.O. BOX 9209 ATO
ALBUQUERQUE, NEW MEXICO 87119

505/262-6425 (24 HOUR)

BRANCH CHIEF: HARRY BETTS

TYPE OF SERVICE/AIRCRAFT/STAFFING

CITATION, BLACKHAWK (ALB)
A-STAR, AEROSPECIAL AS350 (EL PASO)

Stores, Restaurants, Service Stations

Chisos Basin Lodge Restaurant operated by Forever Resorts offers meals for incidents. 432-477-2291 or 2292.

There are several restaurants in Terlingua that are willing to provide meals to incidents.

Chili Pepper Café:	371-2233
Big Bend Motor Inn:	371-2448
Tivo's	371-2133

River outfitters may be willing to prepare lunches for incidents as well.

There are three stores in the Park operated by Forever Resorts. The Study Butte Store in Study Butte has the largest inventory of supplies for support of incidents.

There is one service station operated by Forever Resorts in the Park at Panther Junction. It offers gasoline and diesel. There are 2 service stations offering gasoline and diesel and outside the park in Study Butte.

Terlingua Auto Service is the closest full service mechanic. BIBE auto shop has full service.

Utilities

Rio Grande Electric

ELECTRICAL Coop (432) 729-4318 or (800) 460-0679
Andy White Park Electrician: Wk 477 1135 or Hm 477 2493

WATER

John Lowe Buildings and Utilities Foreman. Wk 477 1131
Hm 477 2553
PJ Water Treatment Plant 477 2278
Eric Stark, Park Plumber 477 1135

PROPANE

John Lowe Buildings and Utilities Foreman Wk 477 1131 Hm 477 2553
Will assist with shutting off and locating lines and tanks.

Mustang Propane supplies the park with propane.

Transportation Resources

Big Bend Fire Mgmt Program has 2 Buses to Transport Firefighters.

1. International (Automatic Transmission) 16 passengers +1 Driver
2. GMC (5 speed Split Differential) 28 passengers +1 Driver

Individuals with Commercial Drivers License:

BIBE Employees: Tony Gonzalez

Steve Benavidez 477-2406

Mark Yuhas 477-2389

Pat Russ 371-2305

Gary Luce 477-2468

John Zubia

San Vicente ISD: Peggy Lipscomb 477-2377

Jim Oberkrom 477-2572

Terlingua Jim Goodnow 432-371-2951

Pierre De Koninick 432-371-2523

Cell 432 294 3506

James Oak 432-371-3069

River Outfitters in Terlingua may have CDL drivers that can assist with Transportation needs.

Bus Companies that can supply drivers and a Bus.

Expeditors 800 255 3119
Lincoln Express 505 384 5480
Carlsbad ISD--Harly Ballard 505 887 1235
Cell 505 706 2223
505 885 4884

Roberts Fleet Bus--Phil Eucker 505 937 0800

Lincoln Zone Dispatch can arrange transportation with contracted and inspected vehicles.
505 437 0778 or the 24 hour # 505 437 2286 or 877-695-1663

OTHER DRIVERS:

CAN USE ANY OF THE ROADS CREW AS DRIVERS FOR ANY NON-ALS EMERGENCY:

ART CASH	CDL	LOOK IN ROLODEX
DOUG FAGG	CDL	477-2207
TRAVIS SIMMONS	CDL	LOOK IN ROLODEX
GENE FOSTER	CDL	477-2235

Rental Equipment Sources

ATV's. – Texas River Expeditions has rented ATV's for prescribed fire support in the past. 432-371-2633

Lincoln Zone Dispatch would be the best resource to get rental equipment for incident support. They have lists of Contract Engines, Tenders, Crews, Port-a-potty, etc. They will also have the resources to contact national sources of rental equipment for full support of incidents.

Toilets

Per Al Mayton, head of Maintenance at Rio Grande Village the Park has 6 port-a-potties that could be set up for initial incident support. These 6 could support up to 180 people per day if the port-a-potties were serviced on a daily basis. 6 more port-a-potties could be pulled from existing sites to supplement the previous six. Bringing the total to 12 port-a-potties servicing 360 people per day. This type of activity could only be maintained for a few days. It's recommended that if more than 6 port-a-potties are needed that outside assistance be requested. Lincoln Zone Dispatch can assist in getting contracted sanitary facilities for large incidents.

Local Fire Departments

ALPINE (432)837-3486
109 N. 8TH
ALPINE, TEXAS 79830

TERLINGUA AREA VFD (432)837-3486
(dispatched by Alpine PD)
P.O.BOX 241
TERLINGUA, TEXAS 79852

Terlingua's Equipment:

- (1) 1000 gal 10 Wheel Driver Pump (not functioning 06/2005)
- (1) 275 gal WEPS 1 ton (Foam Truck)
- (1) 400 gal Pumper Truck 1 ton

(11) Members (1) ECA

MARATHON

Dispatched by Brewster County Sheriff's Office (432) 837-5541

STATE FIRE MARSHALL

AMARILLO-RICHARD BEALS

(806) 468-5861

AUSTIN-

(512) 305-7900

Lincoln Zone Coordination Center
Alamogordo, NM

(505) 437-2286 or (877) 695-1663

Harry Phillips, Center Manager

(505) 434-7354 Cell(505) 430-4349

Beth Spencer, Asst. Center Manager

(505) 434-7352 Cell(505) 430-4380

Texas Interagency Coordination Center
Lufkin, TX

888-324-8707

Cynthia Foster, TxFS

Communications

LOCAL RADIO FREQUENCIES FOR BIG BEND NATIONAL PARK

Portable and Mobile Radios (Revised February 23, 2006)

<u>CH.</u>	<u>AGENCY / FUNCTION</u>	<u>RECEIVE</u>	<u>PL-TONE</u>	<u>TRANSMIT</u>	<u>PL-TONE</u>
01	NPS-LE EMORY	172.600	103.5	169.800	103.5
02	NPS-LE LOCAL	170.075	107.2	170.075	107.2
03	NPS-LE P. GAP	170.075	107.2	168.375	107.2
04	NPS-LE PORT. RPTR.	172.600	103.5	169.800	123.0
05	NPS-ADMIN-EMORY	166.375	192.8	166.975	192.8
06	NPS-ADMIN-LOCAL	166.375	192.8	166.375	192.8
07	NPS-ADMIN 3-4 RPTR.	166.350	192.8	166975	192.8
08	NIIMS LOCAL	168.550	127.3	168.550	127.3
09	ALLIANCE-SUE PEAK	169.450		171.075	100.0 (DES)
10	MEDICS-CHRISTMAS	155.160		153.890	192.8
11	MEDICS LOCAL	155.160		155.160	
12	USC LOCAL (also USDA)	165.2375		165.2375	(DES)

13	USBP ORD	163.700	100.0	162.900	100.0
14	BC-EMORY	155.655	136.5	154.830	136.5
15	BC-ELEPHANT	158.790		154.710	162.2
16	BC-LOCAL	158.790		158.790	
17	ALLIANCE LOCAL	169.450		169.450	(DES)
18	ALPINE HOSP. LOCAL	155.340		155.340	
19	BC-BIRD (Marathon)	158.790	141.3	154.710	141.3
20	USC-PEPPER (Terling.)	165.2375		166.4375	(DES)
21	USBP.ORD (Alpine)	163.775		162.975	123.0
22	TX P&W LOCAL	151.415		151.415	
23	DPS LOCAL	154.950		154.950	
24	Texas Forest Service Statewide	154.280		154.280	No Tones
25	<i>Air to Ground Lincoln Zone both Tx and Rx 166.6875 no tones.</i>				

Sanitary Landfills

Big Bend National Park has its own landfill but due to its size and purpose use of this landfill for large incidents isn't recommended.

The nearest landfill for large incidents would be the Alpine Landfill. 432 837 1168

Portable Water Sources

BIBE Fire Management has 2 1800 gal. Pumpkins and 1 1500 gal Port-a-Tank. Maintenance has a 3000 gal Tender. In the Helitak Shak there is a 125 gallon Blivit that can be transported via helicopter.

Maintenance Facilities

BIBE Park has a full service auto shop.

Terlingua Auto has a nearly full service shop and Tow Truck 432 371 2223.

Contact Information for other Auto and Truck Shops and Tow Trucks is available through BIBE Park Dispatch.

It would be recommended to bring a full Ground Support Unit for large incidents due Big Bend National Park remoteness.

Operations

Helibase, and Helispot Locations

Park Headquarters (Panther Junction) heliport lat/log is
N 29° 19.30' W 103° 12.37'

Bearing from Marfa VOR: 135°

Distance from Marfa VOR: 70 nautical miles

The PJ Helipad could accommodate 3 Type 3 Helicopters. Any change in that configuration would need to be approved by the FMO and the Lead of the Park Aviation Plan or Helibase Manager of Incident.

Many other possibilities exist for Helispots and Dip-sites throughout the park. Laguna Meadows and South Rim areas have been used for helispots. The pullout on the north side of the road just before the Remuda has been used as a dip site.

The following are suggested Helispots and Dip sites. Each area will need to be scouted for hazards and exact location of Helispot and location of Dip Tank.

Sotol Vista Helispot and Dip site (paved parking lot):

N29 12' 52.4" W103 22' 35.1"

**Oak Springs / Cat Tail Falls Parking Helispot and Dip site (gravel):
Large Hill to the East of Helispot.**

N29 17' 00.0" W 103 21' 01.2"

Sam Nail Helispot and Dip site (gravel):

N29 16 42.3 W103 21 51.3

Basin/Remuda Dip site: Hazards Present: Power lines, campground and Trees.

N29 16 28.8 W103 18 15.8

In mountainous areas some pilots have reported unfavorable winds for low level operations.

At the time of writing Lat and Longs for helispots or dip sites other than Panther Junction will need to be confirmed and Lat and Long determined.

AIRCRAFT

UNITED STATES BORDER PATROL MARFA, TEXAS 79843

P.O. BOX I

ROGER AIMS (432)-729-5200(DISPATCH)

AIR OPERATION SUPERVISOR.(432)-729-3313 (WORK)
(432)-729-4707 (HOME)

UNITED STATES BORDER PATROL DEL RIO, TEXAS

DREW DUNCAN.(830)-703-2100 EXT.600
BRANCH CHIEF OF AIR OPERATIONS

TEXAS DEPARTMENT OF PUBLIC SAFETY MIDLAND, TEXAS 79703

2405 S. LOOP 250 WEST

JOHN BRANNON.(432)498-2130 DISPATCH
CHIEF PILOT (432)-498-2100

LANGLEY AIR FORCE BASE COORDINATION CENTER. (800)-851-3051
(Call this number for C.A.P. resources)

UNITED STATES CUSTOMS

1) SAN ANGELO, TEXAS 76906

P.O. BOX 62390
MARTIN VAUGHN.(325)-942-6800 (24HRS)
BRANCH CHIEF AIR OPERATIONS BRANCH

UNITED STATES CUSTOMS

2) ALBUQUERQUE, NEW MEXICO 87119

MARK SCHINDLER. (505)-346-6425 (24HRS)
BRANCH CHIEF '0' FOR OPERATOR
AIR OPERATIONS BRANCH

SECTOR ORLANDO, FL. (800)-973-2867 (24HRS)

(ii) WHEN YOU CALL SECTOR IN ORLANDO, FL FOR A LANE CHECK MAKE SURE YOU IDENTIFY YOURSELF AS NPS-1580, THEN MAKE YOUR REQUEST.

F.A.A. FLIGHT SERVICE STATION(800) 433-8102
SAN ANGELO, TEXAS
TO FILE FLIGHT PLAN. (800) 992-7433
THEN,#*(TONE)*99, THEN GIVE INFO

AVIATION MANAGEMENT DIRECTORATE (AMD)
P.O. BOX 15428 BOISE, ID 83715-5428

TO REPORT AIRCRAFT ACCIDENTS (AMD – 24 hr)(888) 464-7427
FLIGHT COORDINATION CENTER (AMD Boise)(208) 334-9314
AVIATION ACCIDENT PREVENTION & SAFETY MANAGEMENT.(208)387-5800

National Park Service Aviation Contacts

Cliff Chetwin, IMR Aviation Specialist..... (303) 969-2657
Bill Spruill, WASO Aviation Manager..... (202) 513-7134

NOTIFY CUSTOMS WHEN PARK AIRCRAFT FLYING

RIVERSIDE, CA, ASK FOR THE NEW MEXICO DESK. . . .(800)553-9072
DIRECT TO TEXAS PERSON.(909)656-8060
SENIOR DETECTION SPECIALIST.(909)656-8050

CESSNA MODEL 206, NPS104PS, "NPS PATROL" IN BLACK LETTERING ON WINGS, USUALLY SQUAWKING 1200 ON TRANSPONDER

ALBUQUERQUE AIR ROUTE TRAFFIC CONTROL CENTER

(To request a temporary flight restriction, refer to park aviation management plan, Chapter 4) (505)856-4591
(505)856-4654(fax)

**** FOR AMD APPROVED HELICOPTER VENDORS, SEE ATTACHED LIST, CURRENT LISTS WILL BE PROVIDED BY PARK PILOT ****

AIRPORTS

- i) HARTE RANCH AIRSTRIP (BIBE Park Owned and Maintained – not open to public)
- ii) 432 371 2398
 - a. N29 35 28.37 W103 15 58.30
 - b. Length: 3100 feet gravel airstrip

ALPINE MUNICIPAL AIRPORT (E38).....(432)837-5929fax
FORT DAVIS HWY, ALPINE, TX (432)837-3009
8-6PM 7 DAYS/WEEK

MOORE AIRCRAFT.....(432)729-3102
MARFA, TX (JOE MOORE)..... HM (432)426-3100

HARGUS AVIATION..... (432)336-3151
FT. STOCKTON/PECOS COUNTY AIRPORT
FT. STOCKTON, TX 79835

MIDLAND INTERNATIONAL AIRPORT..... (432)560-2200
MIDLAND, TX

TERREL COUNTY AIRPORT..... (432)345-6731

SANDERSON, TX

PRIVATE AIRSTRIP (INFORMATION NOT FOR VISITORS)

PITCOCK ROSILLOS RANCH- FOR PARK USE IN EMERGENCIES, PHONE

Sid (husband) and Mike (wife) Ferris at 477-2266 Managers

ROY PITCOCK Owner AT (800)234-1262,

TO GET PERMISSION AND TO GET GATE UNLOCKED.

- Paved 4100 feet long airstrip and at 3100 feet elevation.
- 12 miles from Park Headquarters and close to Chisos Mountains.

Lajitas Resort Airport (89TE)(432) 424-5000 or 424-3544 (airport)

- Location N 29 15 45 W 103 46 30
- 7500 feet paved, lighted and hangers at 2500 feet elevation.
- Fuel available. Possible to obtain permission for SEATS and Large Air Tankers to land and refuel.

Flight Routes and Restrictions

Flight Route information, local airport Lat and Longs and other aviation information are available in the BIBE Dispatch Mobilization Guide.

The BIBE Aviation Management Plan in Big Bend Dispatch Center contains an Air Craft Pre-accident plan and overdue aircraft procedures.

Procedures for requesting Air Space/Flight Restrictions is found in the BIBE Aviation Mgt. Plan.

Aviation Hazards map for the Park is in the District Rangers office next to the Helipad at Panther Junction.

Water Sources

The Rio Grande River, Tule Tank on the east side of Tule Mountain, and the Chisos Basin Sewage Lagoons are three permanent **potential** sources of water. Use of these sources will need to be confirmed. Other sources will have to be arranged with logistical support. See the Logistical Considerations part of this plan for portable water sources.

Panther Junction, Rio Grande Village, Castolon and the Chisos Basin have public water supplies that can support suppression efforts. They all will require tie in at a hydrant or stand pipe.

Control Line Locations

Roads

Existing paved and dirt roads will provide the best control lines for a Wildland fire incident. Refer to the full set of (1:24,000 scale) USGS topographic maps in park Dispatch or on Engines 3 and 4.

Other opportunities exist for using power line access roads. Resource Management employee (Alex and Corrick) have good knowledge of the location and maps of the roads. The FMO(Morlock) also has knowledge of the location of these roads. At the writing of this plan it is unknown if these roads are marked on any maps in the park. It will be necessary to improve these roads for access and use as control lines since they only get occasional use.

Historic Roads also offer potential for location of control lines for Wildland fire. At the writing of this plan it is unknown if any of those roads are marked on any maps in the park or on the Wildland Engines.

Trails

Many possibilities exist for using existing trails as control lines. Refer to the sets of topographic maps in Park Dispatch or on Engines 3 and 4. Most trails will need to be prepped by removing vegetation to prevent further spread of the fire.

Other Considerations

In some areas the sparse nature of the vegetation could be used as a control line.

Natural Barriers

In lower elevations the sparse and discontinuous nature of the fuels would be a natural barrier. Arroyos could also be considered natural barriers depending on fire behavior and flame length.

In mountainous areas there are numerous large cliff formations that could be used as natural barriers depending on fire behavior and flame lengths. Refer to maps in Park Dispatch or engines 3 and 4.

Safety Zones

In the Chisos Basin Evacuation Plan there are two safety zones in the Chisos Developed area. Refer to that plan for their location.

In the higher elevations accessible by foot there are a few safety zones that could accommodate some firefighters. It needs to be determined exactly how many individuals these safety zones could accommodate. Most potential safety zones would need to be burned out before being used.

Juniper Flats and Boulder Meadows areas along the established trails are options.
The Western end of the South Rim could be used where ground fuels are very sparse.

The South Rim at the end of the Boot Canyon Trail is a possibility where the trees are very spread out and savannah like. This area would need to burn out for use.

Other areas may exist. They will need evaluations before determination.

Staging Area Locations

An excellent candidate for staging area is the Emergency Services Building (ESB). There is plenty of parking for Engines and Crew Buses. The Fire Cache is nearby and a fire hydrant for filling engines is just on the northwest side of the building. Restrooms and potable water are available.

Another good candidate is behind the Ranger Station/Visitor Center in the Chisos Basin. This area provides more limited parking than the ESB but still offers plenty of room for multiple resources. Restrooms and potable water are available. Fire Hydrants are nearby.

Depending on the location of the incident or Initial Attack needs campgrounds could also be used as staging areas.

Planning

Park Base Map and Topographic Maps

Complete sets of USGS (1:24,000 scale) topographic maps of the park can be found in Park Dispatch, and Engines 3 and 4.

Infrared Image

Order an Infrared Flight through Lincoln Zone Coordination Center.

Vegetation and Fuels maps

(Betty Alex will print for final product)

Hazard Locations (Ground and Aerial)

Aviation hazard map is in District Rangers Office at Panther Junction.

Numerous hazards exist in all developed areas. Overhead power lines and buried power lines are common.

Propane tanks are common in Developed areas. Underground propane lines are also common in developed areas.

In mountainous areas terrain is often an extreme hazard. Watch footing and flag dangerous areas.

Several Military Flight Paths exist in the Park.

Archeological/Cultural Base Maps

Please refer to Science and Resource Management Staff for assistance on location of archeological and historical resources.

Archeologist Tom Alex	477-1144
Geologist Don Corrick	477-1142
GIS Specialist Betty Alex	477-1146

Endangered Species critical Habitat

Please contact Science and Resource Management Staff for habitat location.

Wildlife Biologist Raymond Skiles 477 1145
GIS Specialist Betty Alex 477 1146

A map is available for Black Cap Vireo habitat locations. A map is also available for location of Agave species that serve as a food source for the Mexican Long Nose Bat.

Sensitive Plant Populations

Contact Joe Sirotnak, Park Botanist. 477 1148
GIS Specialist Betty Alex 477 1146

Land Status

Nehr property - accessible in-holding south of the Harte Ranch road. Small RV trailer on site.

The Pitcock-Rosillos Ranch is surrounded on three sides by National Park. It is in the central northern portion of the park. The ranch has multiple buildings and structures.

The northwest boundary of the park has been under dispute over the past few years. The status of that situation is not known at this time.

Appendix H -1: Long-Term Prescribed Fire and Hazard Fuel Reduction Plan

Vegetation types: R=floodplain/riparian; DS = desert scrub; HDG = high desert grasslands; SW= shrub woodlands; GW= grassy woodlands; F= forest

Year/ month	Project name	Acres	Condition Class	Vegetation type	Purpose of treatment and monitoring objectives
2005	1314 Junction	531	II	HDG	Reduce hazard fuels and improve egress from Basin exit. <i>Monitor</i> exotic plant species, shrub density, grass cover, species diversity, vegetation structure, recovery rates, agave mortality
2005	Boquillas Cyn Trailhead	10	III	R	Ecological restoration, fuel reduction, reduce saltcedar, exotics <i>Monitor</i> shrub density, grass cover, species diversity, vegetation structure, recovery rates, and non- native cover; cultural resources
2005	Panther Junction Blocks BC	29	II	HDG	Reduce hazard fuels <i>Monitor</i> shrub density, grass cover, species diversity, vegetation structure, recovery rates, and non- native cover
2006	Panther Junction Blocks EF- 2 nd entry	55	II	HDG	Reduce hazard fuels, defensible space <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, rate of recovery, nonnative cover
2006	Tobosa Grass Research Burn	10	II	DS	Research determine fire's role in restoring/ maintaining grasslands <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, recovery rates. Erosion rates. Percent grass recovering by seed & rhizome, soils erosion. Cultural resources
2006	Chisos Basin Blocks BCP	22	II	GW	Reduce hazard fuels, defensible space <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, nonnative cover, agave mortality
2006	SE Rim	370	II	GW/F	Reduce hazard fuels, retain species diversity, vegetation structure, reduce fuels, shrubs, uneven age stands <i>Monitor</i> dead and downed, tree density by size class, foliar and basal cover of herbaceous and woody species and surface cover

Year/ month	Project name	Acres	Condition Class	Vegetation type	Purpose of treatment and monitoring objectives
2006	Santa Elena Canyon Overlook	180	III	R	Ecological restoration, fuel reduction, reduce saltcedar, exotics <i>Monitor</i> shrub density, grass cover, species diversity, vegetation structure, recovery rates, and non- native cover; cultural resources
2006	Sublett Farm Floodplain- 1 st entry	415	III	R	Ecological restoration, cultural restoration <i>Monitor</i> shrub density, grass cover, species diversity, vegetation structure, recovery rates, and non- native cover; cultural resources
2006	SW Rim Line Prep	26	I	GW/F	Reduce hazard fuels, maintain species diversity <i>Monitor</i> dead and downed fuels, tree density by size class, foliar and basal cover of herbaceous and woody species and surface cover. <i>Monitor</i> sensitive species
2007	Basin Campground Blocks FHKLMNO	67	II	SW	Reduce hazard fuels & create safety zone <i>Monitor</i> shrub density, grass cover, species diversity, vegetation structure, recovery rates, agave mortality and non- native cover
2007	Basin Block DEG	70	I	SW/GW	Reduce hazard fuels & create safety zone <i>Monitor</i> shrub density, grass cover, species diversity, recovery rates, agave mortality and non- native cover
2007	Alberico – Moir Long- term monitoring plots.	2.5	II/III	HDG/SW/G W/F	Reduce hazard fuels, assess first entry burns; a 2 nd entry burn <i>Monitor</i> dead and downed fuels, tree density by size class, shrub density, foliar and basal cover of herbaceous and woody species, and surface cover
2007	RGV Campground	10	III	R	Reduce hazard fuels, removal of exotics, defensible space <i>Monitor</i> shrub density, grass cover, species diversity, vegetation structure, recovery rates, and non- native cover
2007	Gambusia pond	6	III	R	Wetland restoration <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, recovery rates, non- native cover
2007	Tamarisk thickets	3 x 20	III	R	Ecological restoration, removal of exotics <i>Monitor</i> tree density by size class, shrub density, foliar and basal cover of herbaceous and woody species, surface cover
2007	SW Rim Rx Burn	170	II	GW/F	Reduce hazard fuels, retain species diversity, vegetation structure, reduce fuels, shrubs, uneven age stands <i>Monitor</i> dead and downed, tree density by size class, foliar and basal cover of herbaceous and woody species and surface cover

Year/ month	Project name	Acres	Condition Class	Vegetation type	Purpose of treatment and monitoring objectives
2007	Green Gulch Mech Reduction A	8	II	HDG/SW	Reduce hazard fuels <i>Monitor</i> tree density by size class, shrub density, foliar and basal cover of herbaceous and woody species, surface cover. Cultural resources
2008	Johnson grass- Harte ranch	2	III	DS	Research fire & exotic species control <i>Monitor</i> % kill/recovery of exotic following fire + herbicide treatment, Shrub density, grass & shrub basal and foliar cover, species diversity. Cultural resources
2008	Buffelgrass – Johnson Ranch Road	2	III	DS	Research fire & exotic species control <i>Monitor</i> % kill/recovery following fire + herbicide treatment; shrub density, grass & shrub basal and foliar cover, species diversity, non- native cover. Cultural resources.
2008	Homer Wilson Ranch site	2	II/III	DS/HDG	Reduce hazard fuels <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, recovery rates, non- native cover
2008	Hannold Draw 2 nd entry	484	II	DS	Reduce hazard fuels <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, recovery rates, non- native cover. Cultural resources
2008	Basin Blocks AIJ	13,5	II	SW	Reduce hazard fuels, improve defensible space <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, rate of recovery, nonnative cover
2008	PJ Blocks GHI	9	II	HDG	Reduce hazard fuels <i>Monitor</i> shrub density, grass cover, species diversity, vegetation structure, recovery rates, and non- native cover
2008	G. fescue micro burns	0.1	II	SW/GW/F	Fuels reduction; Research Guadalupe Fescue establishment <i>Monitor</i> fire effects on species, species diversity, Guadalupe fescue vegetative and reproductive response. Tree density by size class, shrub density, foliar and basal cover of herbaceous and woody species, surface cover
2008	Panther Junction Block D	52	II	HDG	Reduce hazard fuels <i>Monitor</i> Shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non- native cover

Year/ month	Project name	Acres	Condition Class	Vegetation type	Purpose of treatment and monitoring objectives
2008	North Boundary or North Windmill (Chalk Draw)	200	II	DS	Reduce hazard fuels <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non- native cover. Cultural resources
2008	Green Gulch corridor Mech Reduction B	8	II	HDG/SW	Reduce hazard fuels <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, nonnative cover, agave mortality. Cultural resources
2009	Basin (Sewer Lagoon to Panther Pass)	240	II	SW	Reduce hazard fuels in high use corridor. <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, rate of recovery, no- native cover, agave mortality, Cultural resources
2009	Johnson grass- Harte Ranch	2	III	DS	Research grasslands response to fire <i>Monitor</i> % kill/recovery of exotic following fire + herbicide treatment, Shrub density, grass & shrub basal and foliar cover, species diversity
2009	Buffelgrass- Johnson Ranch Road	2	III	DS	Research grasslands response to fire <i>Monitor</i> Percent kill/recovery of exotic following fire + herbicide treatment, Shrub density, grass & shrub basal and foliar cover, species diversity
2009	Homer Wilson Shearing Pen	1	III?	DS	Reduce hazard fuels <i>Monitor</i> Shrub density, grass & shrub basal and foliar cover, species diversity, recovery rates, non- native cover
2009	Lone Mountain 2 nd entry	640	II	DS/HDG	Reduce hazard fuels <i>Monitor</i> Shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non- native cover
2009	Dick- Peddie Plot 4/ Boot Canyon	0.1 acres	II	F	Research burn <i>Monitor</i> tree density by size class, shrub density, foliar and basal cover of herbaceous and woody species and surface cover. Cultural resources
2010	Basin Block BP	13	II	GW	Reduce hazard fuels <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, nonnative cover, agave mortality

Year/ month	Project name	Acres	Condition Class	Vegetation type	Purpose of treatment and monitoring objectives
2010	Panther Junction Block A	56	II	HDG	Reduce hazard fuels <i>Monitor</i> Shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non- native expansion/invasion.
2010	Green Gulch West	200	II	HDG/SW	Reduce hazard fuels <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non- native cover, agave mortality
2010	RGV/Boquillas Overlook	10	III	R	Reduce hazard fuels/control exotic species <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non- native cover
2010	Green Gulch corridor Mech Reduction C	8	II	HDG/SW	Reduce hazard fuels <i>Monitor</i> Shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non- native cover, agave mortality. Cultural resources
2010	RGV- Gambusia Wetland 2 nd entry	10	I	R	Reduce hazard fuels <i>Monitor</i> photo points to observe changes in vegetation structure
2011	Green Gulch corridor Mech Reduction D	8	II	HDG/SW	Reduce hazard fuels <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non- native cover, agave mortality. Cultural resources
2011	Toll Mountain	?	II	F/GW	Research burn – intensity effects <i>Monitor</i> tree density by size class, shrub density, foliar and basal cover of herbaceous and woody species and surface cover. Cultural resources
2011	Maple Canyon Basin	?	II	GW/SW	Reduce hazard fuels <i>Monitor</i> tree density by size class, shrub density, foliar and basal cover of herbaceous and woody species and surface cover, agave mortality. Cultural resources
2011	Gambusia pond- 2 nd entry	6	I	R	Wetland restoration <i>Monitor</i> recovery of natives including seedling establishment, pond flows and water table levels when possible. Cultural resources
2012	SE Canyon Overlook- 2 nd entry	174	III	R	Ecological restoration, control exotic species <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non- native cover

Year/ month	Project name	Acres	Condition Class	Vegetation type	Purpose of treatment and monitoring objectives
2012	Sublett Farm Floodplains- 2 nd entry	415	III	R	Ecological restoration, cultural resource site, control exotics <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover
2012	RGV Campground East	18	III	R	Reduce hazard fuels <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover
2013	Casa Grande- 2 nd entry	230	I	GW/SW	Reduce hazard fuels <i>Monitor</i> tree density by size class, shrub density, foliar and basal cover of herbaceous and woody species, surface cover, agave mortality
2013	Basin Campground	70	II	GW/SW	Reduce hazard fuels <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover, agave mortality
2013	Basin Block DEG	70	II	GW/SW	Reduce hazard fuels <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover, age mortality
2013	Panther Junction Blocks BC-2 nd entry	9	II	HDG	Reduce hazard fuels <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover
2013	SE Rim-2 nd entry	370	II	GW/F	Reduce hazard fuels, maintain species diversity <i>Monitor</i> tree density by size class, shrub density, foliar and basal cover of herbaceous and woody species and surface cover
2014	RGV Campground – 2 nd entry	10	III	R	Reduce hazard fuels, control exotics, create defensible space <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover

Year/ month	Project name	Acres	Condition Class	Vegetation type	Purpose of treatment and monitoring objectives
2014	Basin Blocks BCP	22	II	GW	Reduce hazard fuels, maintain defensible space <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover, age mortality
2014	Panther Junction Blocks EF- 3 rd entry	55	II	HDG	Reduce hazard fuels, maintain defensible space <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover
2014	1314 Junction 2 ND Entry Burn	531	II	HDG	Reduce hazard fuels <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover, age mortality
TOTAL ACRES		5984.2			

While prescribed burns are often planned a year ahead, the availability of funding, weather, equipment and staff, determine when the burn can be conducted safely.

Appendix H-2: EXAMPLE PRESCRIBED BURN PLAN

From RM-18, Chapter 10 (January, 2005)

Prescribed Fire Project Plan Contents: A standard prescribed fire plan form has been developed for use in the National Park Service. However, due to the variety of information required by an individual park unit the plan may be supplemented with additional content provided the minimum elements listed in the standard form are addressed. Each plan **shall include** as a minimum, the following elements:

Signature Page: The approved prescribed fire plan constitutes a delegation of authority to burn. No one has the authority to burn without an approved plan or in a manner not in compliance with the approved plan. Actions taken in compliance with the approved prescribed fire plan will be fully supported. Personnel will be held accountable for actions taken that are not in compliance with elements of the approved plan regarding execution in a safe and cost-effective manner.

Executive Summary: A brief discussion describing the purpose and justification of the project, connection with the overall management of the unit, and description of how it implements the fire management plan.

Description of Prescribed Fire Area:

General Area Description (narrative)

Location (County, Legal, Lat/Long and/or UTM, Fire Management Zone)

Geographic Attributes (Project Size, Elevation Range, Slope, Aspect)

Description of Project Boundaries (Define geographic, natural and human features to be used as the project boundary.)

Vegetation Types: Described the structure and composition of the vegetation type(s) within the project area, the percent of the area composed of this type and the fuel model that corresponds to it. Include plant community class, as available.

Fuels Characteristics: Described fuels as applicable by fuel type. Describe: Fuel type, natural or activity; Fuel Loadings by size class, live and dead, and total; Fuel bed depth; Arrangement; and discussion of past environmental effects on the land and how they have impacted the fuel characteristics as appropriate.

Vicinity Maps – attached as appendices

Project Maps – attached as appendices (include vegetation/fuel maps)

Goals and Objectives: Include purpose and goals of the prescribed fire, as stated in park management and supporting management plans (i.e. Resource Management Plan, Cultural Landscape Plan, Endangered Species Recovery Plan, etc.) Specific objectives of the prescribed fire and protection objectives shall be stated in quantifiable and measurable terms.

Risk Management: The process of identifying and controlling hazards to protect resources and property. This includes implementing a risk management process, which is an analysis of proposed actions, the environment (fuels, topography, weather, etc.) where the project takes place, assessment of

hazards, potential consequences, and mitigation to reduce risk (see Exhibit 2, Hazard Rating Guide; Exhibit 3, Prescribed Fire Risk Analysis Worksheet; and Exhibit 4, Risk – Assessment Matrix). Mitigations to reduce risk are outlined in the Prescribed Fire Risk Mitigation Table, Exhibit 5. The mitigations described are then addressed in the later sections of the prescribed fire plan dealing with project complexity, organization, pre-burn considerations, ignition and holding actions, public and firefighter safety, and monitoring.

A Job Hazard Analysis (JHA), Exhibit 14, is part of this procedure and helps to integrate acceptable safety and health principles into the operation within the Humans Factors element of the Prescribed Fire Risk Analysis Worksheet.

Project Complexity: A prescribed fire complexity rating shall be completed as part of each prescribed fire plan following the process in Exhibits 6 and 7 (Exhibit 6, Prescribed Fire Complexity Rating Worksheet and Exhibit 7, Complexity Value Guide). This process determines the level of organizational structure and support needed to implement the project based on operational, logistical, safety and management needs. The complexity value breakpoints for requiring a Prescribed Fire Burn Boss Type 1 shall be 4 or more Complexity Values rated "High" OR 2 or more of the Primary Factor Complexity Values rated "High" OR when deemed appropriate by the agency administrator or unit Fire Management Officer.

Organization: List required project organization to complete all phases of the project execution. The prescribed fire organization should be developed based on the objectives, risk assessment and project complexity. Specify **minimum** number and type of resources needed. Consider long duration, day/night, and multi-operational period projects where exchange of resources will need to occur.

Cost: Estimated total costs for all phases of the project.

Scheduling: Include proposed ignition date, projected duration. Note any dates when project may not be conducted.

Preburn Considerations: List key on and offsite preburn activities and special precautions and regulations including responsibilities and timeframes. Specify on-site: line to be built, snags to be felled or protected, equipment to be prepositioned, special features to be protected, warning signs to be placed, weather recording and monitoring needs, etc. Specify off-site: burn permits, notifications, media releases, closures, etc. Notifications will show whom we want to contact, who was contacted, who made the contact and when the contact was made. Specify special precautions and regulations: air quality, endangered species, cultural clearances, etc.

Prescription: A prescribed fire prescription contains key weather and fire behavior parameters needed to achieve desired results. Identify ranges of acceptable prescription parameters to obtain desired fire behavior and effects. Attach modeling outputs to justify prescription.

Ignition and Holding Actions: Identify methods, roles and responsibilities,

coordination and special considerations needed. Attach modeling outputs or worksheets (i.e. Fireline Handbook, BEHAVE, etc.) to justify minimum holding resources required. An Incident Action Plan (IAP) is developed for each operational period that defines tactical activities and assignments.

Test Fire: The test fire is intended to evaluate fire behavior characteristics that are necessary to meet the prescribed fire plan objectives. A test fire is completed prior to making the decision to execute the project. It shall be ignited at a location within the prescribed fire area that is representative of the site and in an area that can be easily controlled if fire behavior is unacceptable.

Firing and Ignition: Describe ignition operations including firing techniques and patterns. (attach a map where applicable.) Firing and ignition patterns should address potential changes to weather, topography and fuels. Specific firing and ignition tactics will be documented in the IAP showing necessary resources, safety considerations, equipment, and supplies. These tactics shall be further clarified in the briefing.

Holding Actions: Operations to safely maintain the prescribed fire within prescription, within project boundaries and control all slopovers and spot fires within a predetermined time and size. Consider long duration, day/night, multi-operational period projects where exchange of resources will need to occur.

Critical Holding Areas: Identify those areas where there is a higher likelihood of holding problems along the boundary or outside the burn unit (anticipated locations of numerous spot fires and/or slopovers, changes in fuel type, high value resource near the project boundary, etc.).

Divide the Project Area into subunits such as Branches, Divisions, and Groups, based upon complexity, size, assignments, access, topography, etc. Clearly delineate these on the project map using Incident Command System (ICS) symbols.

Mop-up Operations: Identify proposed actions to secure and patrol project area until the prescribed fire is declared out.

Wildland Fire Transition Plan: Identify actions and notifications needed when the prescribed fire exceeds project boundaries and cannot be controlled within one burning period using on-site holding resources. All further actions will be determined through a new strategy developed in the Wildland Fire Situation Analysis (WFSA) process. Identify who the initial incident commander will be and what notifications will be needed.

Protection of Sensitive Features: Identify treatment and mitigations needed to protect cultural sites, threatened and endangered species, or other sensitive features. Include compliance with all applicable NEPA and NHPA requirements.

Public and Firefighter Safety: Describe public and personnel safety and emergency procedures. Identify safety hazards in and outside the project area, measures taken to reduce or mitigate those hazards, and Emergency Medical Service personnel assigned. The IAP should address communications, medical plan, and incident safety analysis.

Smoke Management: Describe how the project will comply with County, State,

Tribal, and Federal air quality regulations. Include modeling outputs and mitigation measures to reduce potential impacts of smoke production and smoke related safety and health issues, if required.

Interagency Coordination and Public Information: Identify actions, timelines and responsibilities for interagency and intra-agency pre-burn coordination and public involvement.

Media Releases and Public Notice Postings.

Notifications: List of appropriate individuals, agencies and the public to receive notifications.

Monitoring: Describe how the following two elements will be met:

Fire Behavior Monitoring – specify how monitoring of prescription elements will take place pre-ignition and during the burn, including weather, smoke/air quality, and fire behavior observations. Specify on-site weather, smoke, and fire behavior observations required during all phases of the project. Include procedures and responsibilities for acquiring weather and smoke forecasts. May reference park Fire Monitoring Plan, or recommended standards for Level 1 and/or Level 2 fire monitoring guidelines in the NPS Fire Monitoring Handbook.

Fire Effects Monitoring – specify how long and short-term fire effects (vegetation and fuels) monitoring will take place pre-burn and post-burn to evaluate if project objectives have been met. May reference park Fire Monitoring Plan, or recommended standards for Level 3 and/or Level 4 fire monitoring guidelines in the NPS Fire Monitoring Handbook. If plots exist on the unit, include a map of plot locations.

Chapter 11 contains an outline for completing a Fire Monitoring Plan.

Post Fire Rehabilitation: Describe any necessary rehabilitation of disturbances that will be undertaken resulting from management activities of the project. These typically include fireline restoration, minor fence repairs and other mitigation actions that are pre-identified in the prescribed fire plan.

Post Fire Reports: Identify who, what and when various reports associated with this project will be completed.

Appendices: Items to be attached to the prescribed fire plan:

Reviewer Comments - Provides a space for each reviewer to document comments pertaining to the development of the prescribed fire plan.

Technical Reviewer Checklist and Comments

Maps

Prescribed Fire Complexity Rating Worksheet

1) *Periodic Re-Validation Table for multiple operational period burns*

2) *Hazard Rating Guide, Prescribed Fire Risk Analysis Worksheet, and Prescribed Fire Risk Mitigation Table,*

Fire Modeling Outputs

Agency Administrator Go/No-Go Pre-Ignition Approval

Prescribed Fire Operations Go/No-Go Checklist

Appendix I: Fire Prevention Plan

FP ZONE # 1 CHISOS BASIN

HAZARD

HIGH Flashy fuels on steep slopes are continuous. Improvements constructed on mid-slope. One way ingress and egress.

VALUE

HIGH Concession lodge, restaurant, gift shop, Remuda Dorm Housing and Mule Corrals, campground with structures, NPS and Concession housing.

RISK

HIGH Significant historical fire occurrence from lightning and human causes (campground, trails, etc.)

PREVENTION ACTIONS REQUIRED:	RESPONSIBLE PERSON(S)
1. Include fire prevention message in backcountry permit and handouts.	Chief, Interpretation and Visitor Services
2. Include fire prevention message in campground bulletin boards and evening programs, with specific warnings and restrictions when high to extreme ratings are reached.	Chief, Interpretation and Visitor Services
4. Ranger patrols will enforce emergency restrictions.	Chief, Visitor and Resource Protection
5. Inspect all government and concession facilities for compliance with fuel abatement guideline.	Fire Management Officer Chief, Visitor and Resource Protection
8. Hold periodic meetings with residents to discuss issues and provide background and procedures on Chisos Evacuation Plan	Fire Management Officer
9. Conduct cyclic management ignited prescribed burns to manage fuel load	Fire Management Officer

10. Consider sep-up of sprinkler systems around campground and housing area during high to extreme fire danger . Fire Management Officer
11. Fire Management Staff will conduct periodic Patrols through developed area to ensure restrictions are being met. Include fire prevention message targeting wood or ground fires and general caution with all heat sources. Fire Management Officer
12. Broadcast Fire Danger Rating and Restrictions over the Radio. Post Fire Danger Rating on Daily Report Park Dispatch
13. Enforce restrictions during high to extreme fire danger periods through Fire Management Staff patrol. Fire Management Officer

FP ZONE #2 PANTHER JUNCTION

HAZARDS

HIGH Sparse desert shrubs with fingers of flashy fuels throughout area.

VALUE

HIGH Park Visitor Center and Headquarters complex, maintenance buildings, school, employee housing.

RISK

HIGH High historical lightning fire occurrence; human risks associated with congested activities (cooking, vehicle, recreational activities, etc.).

PREVENTION ACTIONS REQUIRED:		RESPONSIBLE PERSON(S)
1.	Display visitor center fire prevention message, including WFU and management ignited prescribed burn rationale. Display Fire Danger Ratings and Restrictions.	Chief, Interpretation and Visitor Services
3.	Include fire prevention message in backcountry permit and handouts.	Chief, Interpretation and Visitor Services
4.	Strengthen and enforce guidelines for fuel reduction around residences.	Fire Management Officer
5.	Inspect hazard fuels around structures.	Fire Management Officer
6.	Conduct cyclic management ignited prescribed burn program to reduce fuel in housing area.	Fire Management Officer
7.	Broadcast Fire Danger rating/restrictions over park radio. Post Fire Danger Rating on Daily Report.	Park Dispatch

FP ZONE #3 BLUE CREEK RANCH

HAZARD

MODERATE Sparse desert shrubs with fingers of flashy fuels through area.

VALUE

HIGH Historic structures (stone) with wooden corrals.

RISK

LOW Few historic fires in area, moderate human cause potential as ranch is on access route to Castolon area.

PREVENTION ACTIONS REQUIRED:		RESPONSIBLE PERSON(S)
1.	Fire Management Staff will conduct prevention and detections patrols. Public Contact will include prevention message and/or WFU/prescribed fire rationale.	Fire Management Officer and Supervisory Forestry Tech
2.	Reduce fuels around base of corral posts.	Fire Management Cultural Resource
3.	Broadcast Fire Danger rating/restrictions over park radio. Post Fire Danger Rating on Daily Report.	Park Dispatch
4.	Ranger patrols will enforce emergency restrictions.	Chief, Visitor and Resource Protection
5.	Enforce restrictions during high to extreme fire danger periods through Fire Management Staff patrol.	Fire Management Officer

FP ZONE #4 RIO GRANDE VILLAGE

HAZARD

LOW/MODERATE Fires along the river are generally contained by natural barriers and are generally less flammable around structures.

VALUE

HIGH Visitor Contact Station, campground, government housing, concession store and gas station

RISK

HIGH Significant historical fire occurrence heavy visitor use.

PREVENTION ACTIONS REQUIRED:

- | | RESPONSIBLE PERSON(S) |
|--|---|
| 1. Include fire prevention message targeting smoking and cooking activities along the river in backcountry permits and handouts. | Chief, Interpretation and Visitor Services |
| 2. Enforce restrictions during high to extreme fire danger periods through Fire Management Staff patrol. | Fire Management Officer |
| 3. Inspect hazardous fuel reduction around all concession and government facilities annually. | Fire Management Officer |
| 4. Broadcast Fire Danger rating/restrictions over park radio. Post Fire Danger Rating on Daily Report. | Park Dispatch |
| 5. Fire Management Staff will conduct prevention and detection patrols. Public Contact will include prevention message and/or WFU/prescribed fire rationale. | Fire Management Officer and Supervisory Forestry Tech |
| 6. Ranger patrols, will enforce emergency restrictions. | Chief, Visitor and Resource Protection |
| 7. Enforce restrictions during high to extreme fire danger periods through Fire Management Staff patrol. | Fire Management Officer |

FP ZONE #5 CASTOLON

HAZARD

LOW Wildfires along the river are generally contained by natural barriers; general area has low fuel loads.

VALUE

HIGH Visitor Contact Station, campground, government housing, concession store and gas station

RISK

LOW Few historical fires, human risks associated with congested recreational activities.

PREVENTION ACTIONS REQUIRED:		RESPONSIBLE PERSON(S)
1.	Include fire prevention message targeting smoking and cooking activities along the river in backcountry permits and handouts. Post fire danger warnings and restrictions.	Chief, Interpretation and Visitor Services
2.	Inspect hazardous fuel reduction around all concession and government facilities annually.	Fire Management Officer
3.	Broadcast Fire Danger rating/restrictions over park radio. Post Fire Danger Rating on Daily Report.	Park Dispatch
4.	Fire Management Staff will conduct prevention and detections patrols. Public Contact will include prevention message and/or WFU/prescribed fire rationale	Fire Management Officer and Supervisory Forestry Tech
5.	Ranger patrols, will enforce emergency restrictions.	Chief, Visitor and Resource Protection

FP ZONE #6 CHISOS MOUNTAINS

HAZARDS

HIGH Flashy fine fuels at lower elevations blend into pinyon pine on steep slopes.

VALUES

LOW Minimal interpretive and trail improvements.

RISKS

LOW to MODERATE Significant historical wildfire record associated with lightning and human activity on trail system.

PREVENTION ACTIONS REQUIRED:	RESPONSIBLE PERSON(S)
1. Advise backcountry users of fire danger warnings and restrictions, and proper smoking and cooking procedures.	Chief, Interpretation and Visitor Services
2. Equip backcountry patrols for initial attack during high to extreme fire danger. Include Fire Prevention Message WFU/prescribed fire rationale during Public Contact	Chief, Visitor and Resource Protection
3. Broadcast Fire Danger rating/restrictions over park radio. Post Fire Danger Rating on Daily Report.	Park Dispatch
4. Fire Management Staff will conduct prevention and detections patrols. Public Contact will include prevention message and/or WFU/prescribed fire rationale.	Fire Management Officer and Supervisory Forestry Tech
5. Ranger patrols, will enforce emergency restrictions.	Chief, Visitor and Resource Protection
6. Enforce restrictions during high to extreme fire danger periods through Fire Management Staff patrol.	Fire Management Officer

FP ZONE #7 RIO GRANDE RIVER

HAZARDS

LOW to MODERATE Fires along the river edge are generally contained by natural barriers.

VALUES

LOW to HIGH Numerous historic ranches (structures) along river corridor.

RISKS

LOW to MODERATE Numerous incendiary and accidental ignitions associated with river travel.

PREVENTION ACTIONS REQUIRED:		RESPONSIBLE PERSON(S)
1.	Advise river users of proper smoking and cooking procedures.	Chief, Interpretation and Visitor Services
2.	Broadcast Fire Danger rating/restrictions over park radio. Post Fire Danger Rating on Daily Report.	Park Dispatch
3.	Fire Management Staff will conduct prevention and detections patrols. Public Contact will include prevention message and/or WFU/prescribed fire rationale.	Fire Management Officer and Supervisory Forestry Tech
4.	Ranger patrols, will enforce emergency restrictions.	Chief, Visitor and Resource Protection
5.	Enforce restrictions during high to extreme fire danger periods through Fire Management Staff patrol.	Fire Management Officer

FP ZONE #8 PERSIMMON GAP

HAZARDS

LOW to MODERATE Desert shrub fuels occasionally support an intense wind-driven fire.

VALUES

MODERATE Visitor Contact Station, government housing

RISKS

MODERATE Low historic fire occurrence, major access route for park.

PREVENTION ACTIONS REQUIRED:	RESPONSIBLE PERSON(S)
1. Construct and install fire danger sign on roadside.	Chief, Facility Management
2. Post fire prevention message (targeting roadside fires) on bulletin board, and include rationale for WFU and management ignited prescribed burns.	Chief, Interpretation and Visitor Services
3. Inspect fuel reduction program around all facilities.	Fire Management Officer
4. Broadcast Fire Danger rating/restrictions over park radio. Post Fire Danger Rating on Daily Report.	Park Dispatch
5. Fire Management Staff will conduct prevention and detections patrols. Public Contact will include prevention message and/or WFU/prescribed fire rationale.	Fire Management Officer and Supervisory Forestry Tech
4. Ranger patrols, will enforce emergency restrictions.	Chief, Visitor and Resource Protection
5. Enforce restrictions during high to extreme fire danger periods through Fire Management Staff patrol.	Fire Management Officer

FP ZONE #9 HARTE RANCH

HAZARD

LOW to MODERATE Sparse desert fuels at Airport Lodge and Ranch Complex. Creosote shrub with some fine fuels at Mountain Lodge.

VALUE

MODERATE Mountain Lodge, Airport Lodge, Harte Ranch headquarters complex.

RISK

LOW Few historical fires, low public visitation, some use by researchers.

PREVENTIONS ACTIONS REQUIRED:		RESPONSIBLE PERSON(S)
1.	Clear fuels from around structures.	Fire Management Officer
2.	Broadcast Fire Danger rating/restrictions over park radio. Post Fire Danger Rating on Daily Report.	Park Dispatch
3.	Fire Management Staff will conduct prevention and detections patrols. Public Contact will include prevention message and/or WFU/prescribed fire rationale.	Fire Management Officer and Supervisory Forestry Tech
4.	Ranger patrols, will enforce emergency restrictions.	Chief, Visitor and Resource Protection
5.	Enforce restrictions during high to extreme fire danger periods through Fire Management Staff patrol.	Fire Management Officer

FP ZONE #10 GENERAL BACKCOUNTRY

HAZARDS

LOW to MODERATE Desert shrub fuels are broken up by natural barriers; fire must be driven by steady winds to reach significant size.

VALUES

LOW Numerous roadside exhibits, campsites, trails, and scientific equipment. Numerous archeological sites may be damaged by suppression actions.

RISKS

LOW to MODERATE Numerous historical lightning fires and occasional human ignitions (vehicle accidents, camping, smoking).

PREVENTION ACTIONS REQUIRED:	RESPONSIBLE PERSON(S)
1. Ranger patrol vehicles to carry initial attack gear during high to extreme fire danger.	Chief of Visitor and Resource Protection
2. Survey dry thunderstorm paths (with lightning) for new fires.	Fire Management Officer
3. Broadcast Fire Danger rating/restrictions over park radio. Post Fire Danger Rating on Daily Report	Park Dispatch
4. Fire Management Staff will conduct prevention and detections patrols. Public Contact will include prevention message and/or WFU/prescribed fire rationale	Fire Management Officer and Supervisory Forestry Tech
5. Ranger patrols, will enforce emergency restrictions.	Chief, Visitor and Resource Protection
6. Equip backcountry patrols for initial attack during high to extreme fire danger. Include Fire Prevention Message WFU/prescribed fire rationale during Public Contact.	Chief, Visitor and Resource Protection

Appendix J: Weather Station Catalogues

Weather Station Inventory for 417401

Station: 417401 Name: PANTHER JUNCTION NESDIS: FA63D150

Type: 4 (RAWS S NFDRS) Create/Mod Date: 15-Dec-2004 Obs Time/Z: 13/CST
 Assoc Man: _____ Prev Stn: _____ Fcst Zone: _____

State: 48-TX County: 43-_____ Lat/Lon: 29 19 39, 103 12 27
 Obs Agy: 3 (USDI NPS) Unit: BIBE Mnemonic: BIBE FS Reg: 3

Fuel Stk: _____ Wdy FM Mea: _____
 Site: 1 Elev: 3750 Asp: 8 Ann Prec: 14.50 Season:
 Ltng scale: 1.00 Hum code: 2 Temp code: 1 Pres code: 1
 Wind Spd code: 1 KBDI: 275 One/Ten Fl: N

User: NPS7131 Acc Lst: BIBE
 Comments: LAT AND LONG ON NAD 83

P	**	78	NFDRS	Only	**	88	S	G	C	Staffing	Idx	Breakpnts	
r	H						S	l	r	l	Low	High	
i	FM	S	Herb	Date	Date	b	p	s	i	SI	DC	SI% Val	SI% Val
1	7L	C		12-nov-04	28-mar-04	_	1	P	1	BI	5	90	53 97 67
2	7T	C		12-nov-04	28-mar-04	_	1	P	1	BI	5	90	71 97 94
3	7G	C		12-nov-04	28-mar-04	_	1	P	1	EC	5	90	72 97 83

NESDIS	S#	Description	SHEF
FA63D150	9	RAIN ACCUMULATION, INCHES	PC
FA63D150	10	WINDSPEED, MILES PER HOUR	US
FA63D150	11	WIND DIRECTION, DEGREES	UD
FA63D150	12	AIR TEMPERATURE, DEGREES F., STANDARD PL	TA
FA63D150	13	FUEL TEMPERATURE, DEGREES F.	MT
FA63D150	14	RELATIVE HUMIDITY, PERCENT	XR
FA63D150	15	BATTERY VOLTAGE, VOLTS	VB
FA63D150	17	FUEL MOISTURE, PERCENTAGE	MM
FA63D150	18	WIND DIRECTION, DEGREES, PEAK	UX
FA63D150	19	WINDSPEED, MILES PER HOUR, PEAK	UP
FA63D150	20	SOLAR RADIATION, WATTS	RD

Weather Station Inventory for

417403

Station: 417403 Name: CHISOS

NESDIS: FA635744

Type: 4 (RAWS S NFDRS) Create/Mod Date: 05-Dec-2004 Obs Time/Z: 13/CST
Assoc Man: _____ Prev Stn: _____ Fcst Zone: 803

State: 48-TX County: 43-_____ Lat/Lon: 29 16 15, 103 17 57
Obs Agy: 3 (USDI NPS) Unit: BIBE Mnemonic: BIBE FS Reg: 3

Fuel Stk: _____ Wdy FM Mea: _____
Site: 2 Elev: 5400 Asp: 0 Ann Prec: 18.50 Season:
Ltng scale: 1.00 Hum code: 2 Temp code: 1 Pres code: 1
Wind Spd code: 1 KBDI: 275 One/Ten Fl: N

User: NPS7131 Acc Lst: BIBE

Comments:

P	**	78	NFDRS	Only	**	88	S	G	C	Staffing	Idx	Breakpnts	
r	H						S	l	r	l	Low	High	
i	FM	S	Herb	Date	Date	b	p	s	i	SI	DC	SI% Val	SI% Val
1	7L	C		15-apr-04	04-apr-04	_	4	P	1	BI	5	90 60	97 72
2	7F	C		15-apr-04	04-apr-04	_	4	P	1	BI	5	90 134	97 162
3	7H	C		15-apr-04	04-apr-04	_	4	P	1	BI	5	90 43	97 49
4	7G	C		15-apr-04	04-apr-04	_	4	P	1	EC	5	90 72	97 83

NESDIS	S#	Description	SHEF
FA635744	9	RAIN ACCUMULATION, INCHES	PC
FA635744	10	WINDSPEED, MILES PER HOUR	US
FA635744	11	WIND DIRECTION, DEGREES	UD
FA635744	12	AIR TEMPERATURE, DEGREES F., STANDARD PL	TA
FA635744	13	FUEL TEMPERATURE, DEGREES F.	MT
FA635744	14	RELATIVE HUMIDITY, PERCENT	XR
FA635744	15	BATTERY VOLTAGE, VOLTS	VB
FA635744	17	FUEL MOISTURE, STICK WEIGHT, 10 HR PERCE	MX
FA635744	18	WIND DIRECTION, DEGREES, PEAK	UX
FA635744	19	WINDSPEED, MILES PER HOUR, PEAK	UP

Appendix K: WILDLAND FIRE IMPLEMENTATION PLAN

(Insert CD here)

Appendix L: BURNED AREA EMERGENCY STABILIZATION AND REHABILITATION PLAN

Emergency stabilization and rehabilitation activities address disturbance created as a result of fire suppression activities and disturbance caused by the potential effects of the fire itself. The fire suppression rehabilitation is done as part of the wildland fire operations, such as raking in hand-line construction and occurs shortly after the fire has been contained or declared out. These costs are generally covered by the fire. Burned area emergency stabilization and rehabilitation (BAER) addresses potential impacts on park resources as a result of the fire itself and is funded separately from the wildland fire through the Burned Area Emergency Response Program. This involves assessing the fire and the potential damage to park resources including minor structures, roads and trails, cultural and natural resource, park infrastructure. A plan must be drafted that assesses the threat with recommended treatments and associated costs to each resource at risk. Emergency stabilization addresses immediate threats such as those that will be negatively impacted by the next intense thunderstorm. Rehabilitation address those resources impact by the fire but the threat is not immediate, such as seeding to prevent the establishment of non-natives in areas were burn severity is high. The plan must be submitted within seven days of the fire being controlled. Because of the immediacy of the plan it is recommended that the park obtain outside resource in the form a BAER team to assist in drafting the plan.

Rehabilitation of Suppression Actions

As soon as the fire poses no significant threat to park resources and with approval of the Incident Commander, rehabilitation of areas impacted by fire suppression activities can begin. Rehabilitation of suppression impacts are to be charged to the fire. Type I and II crews released from fire suppression operations can be resigned to accomplish much of this work. Areas that may need to be addressed will be the following:

- Hand-line rehabilitation:
 - Soil berms as a result of handline construction will need to be raked back into place.
 - Seeding may or may not be needed. Consult with a resource advisor for their recommendation.
 - In some instances standing snags or charred trees may be cut and placed across the hand line in such a way that water is diverted off and away from the hand-line to prevent channelization. Straw waddles or other suitable material may be used in place of standing dead snags or trees.

- Where a safety zone was created by clearing brush or trees the resulting slash may need to be bucked into smaller pieces and scattered across the site.
- Dozer/Grader Line rehabilitation:
 - Dozers lines created to protect park infrastructure at Panther Junction or the Chisos Basin from a rapidly advancing fire will require rehabilitation. This will require blading disturbed soil back into place, possibly seeding and mulching to create safe sites for seedling establishment and to prevent invasive from becoming established. Prescriptions for this will need to be developed with a resource advisor.
- Retardant dropped onto structures may need to be removed to prevent staining of structures built during the CCC era. Most susceptible is unpainted stone masonry. There are no open bodies of water or streams near where a retardant drop is most likely to occur. The potable water supply for both Panther Junction and the Chisos Basin is from ground water and is in no danger of contamination from retardant.

Burned Area Emergency Response Plan (BAER)

Most areas of the park that burn will not require emergency stabilization or rehabilitation. The primary area that may possibly need a response plan and mitigation are resources in the Chisos Basin and the watershed above. The primary threat would be from increased runoff and debris flow that could damage cottages and the lodge, choking culverts and damaging bridges. The magnitude of the threat would need to be assessed to determine what level of mitigation, if any, is needed. If it is found that mitigation is needed a plan would be developed that would identify what measures are to be taken and the associated costs. This plan could be submitted to the regional office to determine eligibility for BAER funding. If mitigation exceeds the capability BAER funding such as the replacement or repair of major facilities or infrastructure other funding source will need to be pursued. This plan would need to be submitted within 7 days of the fire being controlled or declared out. Values potentially at risk could include, but not limited to the following:

- Natural Resources (threatened and endangered species, sensitive species, and exotic species. In the case of federally listed species emergency consultation with the Fish and Wildlife Service would be required).

- Cultural Resources (If culturally significant resources are at risk emergency consultation with the State SHPO will be required)
- Structures
- Electrical power distribution (transmission lines, transformers, substations, etc)
- Communications: telephone lines, radio repeaters, etc.
- Water supply: this could include damage to pumping and or water storage facilities, contamination of potable water supply, etc. (Consultation with Texas Commission of Environmental Quality (TCEQ) may be required)
- Sewage treatment facilities: (Consultation with Texas Commission of Environmental Quality (TCEQ) may be required)
- Roads and trails: This would include choked culverts, damaged bridges and accelerated erosion on trails.

Below is the procedure to be followed in the event of a fire that could place high value area(s) or resources at risk.

1. As soon as possible, while the fire is ongoing, assemble the park's resource management staff, Building and Utilities Staff and Roads and Trails staff.
2. If a substantive threat exists warranting the development of a Burned Area Emergency Response plan; consult with the Intermountain Region BAER coordinator for concurrence. Once the concurrence is obtained determine the level of assistance needed and order needed resources through Lincoln Zone. This could included the following resources:
 - BAER Team Leader
 - GIS Specialist
 - BAER Hydrologist
 - BAER Soil Scientist
 - Archeologist
 - Wildlife Biologist
 - Vegetation Management Specialist /
 - Botanist
 - Ecologist
 - Weed Specialist
 - Civil Engineer.
 - Document Clerk
 - NEPA Specialist

At a minimum a BAER team leader will work with park staff in developing a plan and then compiling it for submission with the superintendent's approval. It is strongly recommended that in addition to the BAER team leader, a BAER hydrologist and BAER soil scientist,

supported by a GIS specialist be ordered. The BAER hydrologist, soil scientist supported by GIS specialist are trained to work with Burned Area Reflectance Classification (BARC) maps and will provide park staff with a better overall assessment of the fires impacts on park resources. The park, together with the BAER Team Leader can determine if additional resources are needed to assist park staff in developing the BAER plan. **Note:** the BAER Team Leader, as with the IC, works for the Park Superintendent and receives Designation of Authority from the Superintendent.

3. Prior to BAER team arrival, identify a working location separate from the ICP, assuming the fire is ongoing, that the BAER Team can work and not hinder normal park operations. The location must also have electrical power, internet access, and telephone communications.
4. Provide a location for morning and evening briefings for BAER Team and Park Staff.
5. Provide needed data to assembled BAER team including GIS data, such as location of critical resources, soil maps, vegetation maps, infrastructure maps, and other relevant data.
6. If mitigation measure(s) are needed their justification(s) must be documented, with associated prescription(s) and appropriate NEPA compliance for the proposed action.
7. Once the plan is completed and the superintendent has been briefed and approved the plan it is submitted to the Intermountain Region BAER coordinator who will review the plan and then forward to the National NPS BAER Coordinator in the NPS National Fire Program Center in Boise, ID.

Specific considerations of every Burned Area Emergency Rehabilitation (BAER) effort will consider these sensitive species and resources:

- The endangered Mexican Long-Nosed Bat (*Leptonycteris nivalis*) and their supportive habitat, covering 122,600 acres of the Park.
- The endangered fish species, Big Bend Gambusia (*Gambusia gaigei*), that lives in small ponds at Rio Grande Village.

While it is not possible to forecast future fire locations, below are some values at risk from fire and potential watershed response to fire at Big Bend National Park

The endangered black capped vireo (*Vireo atricapilla*). The Big Bend population is small even though suitable habitat is abundant (Cornelius 2004).

-
- The threatened Chisos Mountain Hedgehog Cactus (*Echinocereus chisoensis* var. *chisoensis*).
- Numerous cultural resources, including both historic and prehistoric sites.
- Numerous rare plant species and communities, particularly those concentrations of rare species found in the Chisos Mountains.
- Steep slopes and redouble soils laid bare by fire.
- The concentration of park developments in the Chisos Basin vicinity, including the Chisos Mountains Lodge, Visitor Contact Station, and campgrounds.

Other issues of concern include the potential for spread of non-native plants, primarily Bermuda grass, salt cedar, giant reed, buffelgrass and Lehmann lovegrass. The invasive buffelgrass (*Pennisetum ciliare*) occupies the spaces between desert shrubs, including areas that are not naturally vegetated, thus creating a continuous fuel load and changing the fire frequency of the environment. Related to this concern, is the common use of grass seeding post-fire to protect watersheds from soil erosion and to provide competition with the invasive grass species. There is some indication that the seeding of native grass species may be less effective than seeding of non-native perennial grass species in suppressing the growth of invasive grasses.

This plan addresses what emergency stabilization or rehabilitation that can generally be expected from suppression activities or from direct effect of the fire. Other factors may arise that are not addressed in this general rehabilitation plan. These unanticipated factors will need to be addressed by the IC or BAER team, in collaboration with park staff.

Appendix M: Example Delegation of Authority

As of _____, I have delegated authority to manage the _____ Fire, Big Bend National Park to Incident Commander _____. Your expertise in the management of wildland fires will assist Big Bend National Park in accomplishing stated land and resource management objectives. In order to carry out this responsibility, I want to ensure that you are aware of the following constraints and special concerns.

My objectives for this _____ are:

- Provide for fire fighter and Park visitor health and safety.
- All newly established fireline will be rehabed.
- _____
- _____
- _____
- _____

Considerations for management of the _____ fire are:

My resource advisors (READ) will be Fire Ecologist, Richard Gatewood or Biologist, Raymond Skiles or Botanist, Joe Sirotnak or Geologist, Don Corrick or Archeologist Tom Alex. A READ should be contacted immediately after the fire is reported. If these designated READs are unavailable, contact the Chief of Resource Management, Vidal Davila, for an alternate.

	Office	Home	Cell
Rick Gatewood	432-837-7056	432-837-1456	432-770-8785
Raymond Skiles	432-477-1145	432-477-2232	
Joe Sirotnak	432-477-1148	432-477-2229	
Don Corrick	432-477-1142	432-477-2306	
Tom Alex	432-477-1144	432-371-2917	
Vidal Davila	432-477-1143	432-477-2358	

Key resource considerations are:

- * Threatened and Endangered plant and animal habitat
- * Sensitive Plant Habitat
- * _____
- * _____

* _____
* _____

Key cultural features requiring priority protection are:

- * Archeological Sites
- * Historic Sites
- * _____
- * _____
- * _____
- * _____

Restrictions for management actions are:

- * No tracked or wheeled vehicles in the proposed wilderness.
- * Leave standing snags unless they present a hazard to personnel assigned to the fire or future trail users.
- * Manage any suppression activities to minimize deterioration of Park trails.
- * Manage the fire with as little environmental damage as possible (use MIST techniques).
- * Manage the fire cost-effectively for the values at risk.
- * _____
- * _____
- * _____

Acceptable minimum tools

- * water bucket drops
- * use of fugitive retardant in areas where water drops will not be as effective
- * Type II or III helicopters preferred
- * chainsaws
- * pumps
- * _____
- * _____

My agency advisor will be the Park Fire Management Officer John Morlock.

Provide maximum training opportunities for the National Park Service, Interagency Fire Use Management Team, and cooperators to increase organizational effectiveness.

Minimum disruption of visitor access to the Park trails into the High Chisos backcountry.

Contain escapes or spots as efficiently as possible - acreage is not a controlling factor.

Superintendent
Big Bend National Park

Appendix N: Incident Complexity Analysis- Incident Type 3, 4, and 5

Incident Complexity Analysis (Type 3, 4, 5)

	Yes	No
<i>Fire Behavior</i>		
Fuels extremely dry and susceptible to long-range spotting or you are currently experiencing extreme fire behavior.		
Weather forecast indicating no significant relief or worsening conditions.		
Current or predicted fire behavior dictates indirect control strategy with large amounts of fuel within planned perimeter.		
<i>Firefighter Safety</i>		
Performance of firefighting resources affected by cumulative fatigue.		
Overhead overextended mentally and/or physically.		
Communication ineffective with tactical resources or dispatch.		
<i>Organization</i>		
Operations are at the limit of span of control.		
Incident action plans, briefings, etc. missing or poorly prepared.		
Variety of specialized operations, support personnel or equipment.		
Unable to properly staff air operations.		
Limited local resources available for initial attack.		
Heavy commitment of local resources to logistical support.		
Existing forces worked 24 hours without success.		
Resources unfamiliar with local conditions and tactics.		
<i>Values to be protected</i>		
Urban interface; structures, developments, recreational facilities, or potential for evacuation.		
Fire burning or threatening more than one jurisdiction and potential for unified command with different or conflicting management objectives.		
Unique natural resources, special-designation areas, critical municipal watershed, T&E species habitat, cultural value sites.		
Sensitive political concerns, media involvement, or controversial fire policy.		
If you have checked "Yes" on 3 to 5 of the analysis boxes, consider requesting the next level of incident management support.		

MISSION
DEPARTMENT OF THE INTERIOR

*As the Nation's principal conservation agency,
the Department of the Interior has responsibility
for most of our nationally-owned public lands
and natural resources.*

*This includes fostering sound use
of our land and water resources;
protecting our fish, wildlife, and biological diversity;
preserving the environmental and cultural values
of our national parks and historical places;
and providing for the enjoyment of life through outdoor recreation.*

*The Department assesses our energy and mineral resources
and works to ensure that their development
is in the best interests of all our people
by encouraging stewardship and citizen participation in their care.*

*The Department also has a major responsibility
for American Indian reservation communities
and for people who live in island territories under U.S. administration.*



MISSION
NATIONAL PARK SERVICE

*The National Park Service preserves unimpaired
the natural and cultural resources and values
Of the National Park System
for the enjoyment, education, and inspiration
of this and future generations.*

*the Park Service cooperates with partners
to extend the benefits
of natural and cultural resource conservation
and outdoor recreation throughout the Country.*

**National Park Service
U.S. Department of the Interior**



Big Bend National Park, Texas

**Fire Management Plan
Environmental Assessment**



Fire Management Plan

Environmental Assessment

Big Bend National Park • Texas

Abstract

Big Bend National Park needs to update its fire management plan (FMP) incorporating new policies and advances in fire research and operations. In developing the FMP staff considered public health and safety, the use of fire to accomplish resource management objectives, the need to base the program on science, and that the process be open and cooperative. Three alternatives are retained for analysis in this Draft Environmental Assessment (EA). The No Action Alternative, Alternative A, follows the current management direction and is retained as a basis for comparing other “action” alternatives. Alternative A uses prescribed burns and manual thinning to protect developments. Restrictive decision criteria governing natural ignitions have resulted in suppression of most lightning strikes. Alternatives B and C maintain protection of developments and sensitive resources, but reduce the likelihood of high-severity fire by allowing more fire to reduce hazard fuels. Prescriptions and decision criteria are more flexible than under No Action allowing fuel loads to be reduced to safer levels more quickly. Under Alternative B there is confidence that despite decades of suppression, habitats and species will recover following potentially widespread fire. Proponents of Alternative C are more cautious and propose using fire effects information from research burns to understand how to introduce fire without compromising park values and resources. For these reasons, Alternative C is the NPS preferred and environmentally preferred alternative. Fire management strategies proposed for Big Bend National Park would result in some short-term adverse effects to plants, animals and views. Reduction of fuels, particularly in the Chisos Mountains, is expected to reduce the likelihood of high-severity fire resulting in long-term benefits for the park.

Public Comment

If you wish to comment on this Environmental Assessment, you may mail comments to the name and address below. This environmental assessment will be on public review for 30 days and we will accept comments until June 31, 2005. Please note that names and addresses of people who comment become part of the public record. **If you wish us to withhold your name and/or address, you must state this prominently at the beginning of your comment.** We will make all submissions from organizations, businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses available for public inspection in their entirety.

Send comments to:

John H. King, Superintendent
Big Bend National Park
Panther Junction
Texas 79834

Direct technical inquiries to:

Richard Gatewood (Fire Ecologist) at 432-837-7056

Obtain the EA by:

Accessing the park web site at: www.nps.gov/bibe/home.htm or calling
Raymond Skiles (BBNP Wildlife Biologist) at 432-477-1145

United States Department of the Interior • National Park Service • Big Bend National Park

Executive Summary

Overview

Big Bend National Park needs to update its fire management plan (FMP) to incorporate new policies and advances in fire research and operations. Original meetings suggested that any change in fire policy could lead to significant or controversial consequences under NEPA guidelines, thus an Environmental Impact Statement (EIS) was proposed. Analysis of the three fire management alternatives retained for consideration, however, suggests much smaller impacts than originally thought and none were found to be significant or controversial. Subsequently a notice of intent NOI was published in the Federal Register on December 17, 2004 to announce the change from drafting an EIS to draft an Environmental Assessment, hereafter EA. The level of analysis of effects is the same for both documents however the approval process, is more streamlined for an EA because its findings reveal no significant impacts to the environment from the proposed management actions.

Goals and objectives for the fire program, and resources and values most likely impacted by fire were identified at an internal scoping meeting at the park December 11 and 12, 2002. Staff used two documents, the NEPA mandatory topics and the NPS Environmental Screening Form to develop the direction for fire program activities and the three fire management alternatives. Two public scoping meetings were held at Alpine and Study Butte, Texas, on the 26 and 27th of June 2003, respectively, to comment on staff findings. NPS staff from Denver and Phoenix involved in the review of the EA amended the impact topics in November 2003. They expanded the scope of life and property to include neighbors and boundary issues, added two new topics, watershed effects and resources for the fire program, and enlarged vegetation to include fire effects to wilderness, unique habitats, and exotic species. An Interdisciplinary Team (IDT) representing resource specialists from the park together with a cooperating agency, the University of Arizona, has been primarily responsible for developing this EA.

Four themes and corresponding chapters shape this EA. Chapter I identifies the needs and purpose of the FMP in meeting fire program goals and objectives and the areas or topics most likely to be affected by fire within the park. These eight impact topics were distilled from the extensive list developed in the internal scoping meeting. They are (1) life and property, (2) visitor experience, (3) local economy, (4) vegetation (5) threatened and endangered species (6) cultural resources (7) watershed effects, and (8) resources for the park fire program. Chapter II examines alternative fire management approaches, dismisses unreasonable ones, and looks at how well the remaining alternatives meet the fire program goals. Chapter III provides the background for the impact topics. Chapter IV analyzes the potential environmental consequences of the proposed fire management alternatives on the impact topics.

Fire Management Alternatives

The fire management alternatives differ with respect the extent the four fire management tools are employed – (1) natural fire also called wildland fire or lightning ignitions, (2) suppression, (3) prescribed fire (ignited by management to accomplish resource objectives), and (4) non-fire treatments such as mechanical and manual thinning. Fire is used to accomplish resource objectives within fire management units (FMUs). FMUs are distinct areas of the park with designated fire management strategies.

Alternative A, the No Action Alternative, continues the management direction laid out in the Big Bend 1994 FMP. This alternative has two FMUs. FMU 1 is a geographic area containing developments, a mile buffer strip along the park boundary, populations of threatened and endangered species, cultural resource sites and a northwesterly triangle bounded by the northern park border and State Highway 118 and US Highway 385. Fuel reduction is achieved by prescribed burning and manual or mechanical thinning. Suppression of all other fires is mandatory in FMU 1 including along the park boundary to contain fire on federal lands. The second FMU 2 covers the rest of the park and allows natural ignitions. Strict criteria governing initial decisions on fires however, have meant few fires have been allowed to burn. These criteria were preceded by a overgrazing prior to the park's establishment which, coupled with

suppression, have changed the park's fire regime allowing an increase in shrub cover in the desert. In the upper elevations of the park a reduction in fire occurrence has served to increase the amount of dead and downed woody debris on the forest and woodlands floor and increase the density of trees and shrubs. This increase in available fuel increases the probability of high-severity fire that could forever affect endemic and charismatic species, and alter views and habitats greatly valued by the public.

Alternative B, or Full Wildland Fire Use also has two FMUs. The first FMU 1 contains the same elements as Alternative A without the northwestern area bounded by the highways and with more flexible criteria governing management of fire along the park boundary. Where neighbors agree, the one-mile boundary buffer under Alternative A has been removed to allow fires to burn to man-made or natural topographic barriers such as the rivers or dry washes, cliffs, roads or bare areas. Fire-fighting safety and efficiency is expected to be greatly improved, and impacts to soils and vegetation from suppression activities reduced. The second FMU 2 allows for wildland fire throughout the rest of the park where fires will be allowed to burn within prescriptions at low to moderate intensities. Decision criteria allowing natural ignitions are more flexible and broad under this alternative, and more natural ignitions are expected to reduce fuels, create mosaics of burned and unburned vegetation that would benefit wildlife, facilitate post-fire recovery and provide greater plant diversity. Prescribed fire objectives are to maintain or enhance mature woody vegetation, especially the long-lived, mature trees in the Chisos. Prescriptions to meet these objectives will need to be developed.

Proponents of Alternative B advocate urgent reduction of fuel loads, particularly in the Chisos where a major natural fire has been absent for over 100 years resulting in significant fuel increases. Resource managers acknowledge the growing risk of a stand-replacing fire as fuels build up and fires continue to be suppressed under Alternative A. Allowing more natural fire is proposed even when the fire effects are unknown and may be adverse. Proponents of this alternative are confident that allowing more burns now will be less costly in the long-term than investing resources in high-cost suppression of a widespread, high-severity fire. Alternative B may ultimately reduce the risk of large-scale, high-intensity fires to a greater degree than the other alternatives.

Alternative C or Progressive Wildland Fire Use outlines a process for reintroducing fire safely while balancing public values and safety, responsibilities for rare and endangered species, and improving ecosystem health. This Alternative also has two FMUs. Prescriptions for protecting developments, threatened and endangered species, cultural resource sites and managing boundary fires are the same as FMU 1 in Alternative B. Under FMU 2 natural ignitions are allowed within prescriptions and where fuel levels indicate that wildland fire can burn safely, the same as Alternative B. To protect highly valued mature trees, charismatic, rare, and relict plant species in the Chisos, FMU 2 also has a Special Treatment Zone. Fires may be allowed within prescription depending on site, or suppressed until research results indicate likely outcomes. These proposed research fires form the third component of Alternative C aimed at supporting science-based management in the park. Fire effects will be monitored with respect to sensitive species and habitats, at differing intensities, and in different seasons. This information builds on work begun in the late 1970s and early 1980s and will allow more informed management decisions on the reintroduction of wildland fire into sensitive habitats and landscapes, help facilitate the restoration of native grasslands, possibly maintain and enhance habitat of listed species, and contribute to the control of invasive exotics in concert with other measures.

Alternative C allows for the measured introduction of low to moderate intensity wildland fire particularly in the Chisos based on the results from research burns. These results provide the stepping-stones to understanding how to reintroduce fire safely into a landscape following overgrazing prior to the park establishment and 60 plus years of a fire suppression management policy. This alternative acknowledges that historical vegetation communities, and fire return intervals are not well documented and a more careful, research-based approach to introducing fire is warranted. Resource managers also acknowledge

that fuel levels will continue to increase in the Chisos while research results are being understood and that a stand-replacing fire could occur before research results are applied.

Summary of Alternatives

Alternative A maintains the current direction suppressing most natural fires and allowing fuels to increase; Alternative B allows natural ignitions where fuels assessment has occurred, and may reduce hazard fuels quickest; and, Alternative C proposes research burns to gain knowledge about fire management in complex habitats to improve future management decisions, thereby providing greatest long-term protection of valued resources.

Elements Common to All Alternatives

Fuel treatments:

1. **Wildland fire use:** Wildland or natural fires are ignited by lightning and are most common preceding the summer monsoon followed by a second peak in mid July. More wildland fire is allowed under Alternatives B and C with flexible decision criteria governing ignitions. Resource managers prefer natural fire as a tool as it is more cost effective than prescribed burning of similar area, and it occurs during seasons when fires historically occurred. Fires are monitored daily or more frequently in accordance with the Fire Monitoring Handbook (UDSI 2003) and the Wildland Fire Implementation Plan. The park will continuously update information on fire location, size, behavior, smoke dispersal, road closures and safety conditions, making this information available to every division within the park, and to merchants and visitors.
2. **Prescribed fire:** Under predetermined conditions or prescriptions, resource managers intentionally ignites fires to achieve resource objectives. Prescribed fire is proposed to reduce fuels around buildings, remove hazard fuels in the vicinity of cultural resource sites, maintain habitats of listed species, restore grasslands, or aid in the control of exotics, and where appropriate restore or maintain natural vegetation or reduce excessively high fuel loadings throughout the park.
3. **Monitoring precedes and follows prescribed burns** to record vegetation species and conditions and characterize fuel conditions and document changes following the fire. Surveys for cultural resources and sensitive species are also conducted prior to a prescribed burn and mitigating actions are taken. A prescribed burn program for the park began in 1980 and new projects outlined until 2012. Weather and fire behavior will be monitored throughout prescribed burns and mitigation measures developed prior to the burn. The Fire Monitoring Handbook (USDI 2003) will be used as a basis for monitoring but will be modified as more research data becomes available. Multiple low intensity prescribed burns may be needed to reduce fuels sufficiently to allow wildland fire to resume in some areas of Big Bend. The long-term objective is to, where reasonable, diminish the role of prescribed fire and to more fully allow naturally fire to resume its natural ecological role in the park. In time prescribed fire may be indentified as tool to use on an ongoing basis to maintain some sites, which may include cultural landscapes.
4. **Non-fire treatments:** Fuels may be reduced mechanically with chainsaws or manually with handheld tools to reduce fuels or create firebreaks. The park uses these methods around buildings and intends to also use them around historic buildings and sites where fire and or suppression activities could cause permanent damage. Expected expansion of the cultural resource inventory through monitoring activities will necessitate more attention to maintain these sites and possibly an increase in non-fire treatments.

Information collection

5. **Monitoring** is a key feature to gain knowledge about the dynamics of fire disturbance on vegetation. Baseline data on vegetation is required prior to prescribed burns for all alternatives. More monitoring

is proposed under the action alternatives to better understand fire effects on species and sensitive habitats, fire dynamics under different intensities to help meet natural and cultural resource objectives. Most monitoring will occur under Alternative C – pre and post-fire monitoring of research burns and prescribed fire, and all other fire related activities that may provide useful data and which the park has the resources to measure. Guidelines for monitoring are to meet criteria for scientific research and enable incorporation into management decisions and operations.

Management approaches

6. The park is guided by “Appropriate Management Response” (AMR) that assesses weather, staffing and available equipment, threats to resources, land use, regional issues and other concerns in making a management decision about whether to suppress, contain, or allow a fire to burn. It means that a variety of responses are possible for a given set of circumstances. Unplanned Human caused fires, such as from unattended camp fires, discarded cigarettes or arson, are automatically suppressed using tactics that causing the least amount of damage to resources, people and property. Minimal Impact Suppression Techniques (MIST) are tools available to achieve the AMR. MIST is employed to minimize damage to the landscape while providing safety and meeting resource protection objectives, especially in wilderness. Staging areas and firelines are placed where they will do least damage. Natural breaks are used where possible minimizing ground disturbance or tree cutting. Agency resource advisors will be consulted to determine appropriate management tactics. Heavy equipment such as dozers and road graders will not be allowed for fire suppression operations unless under extreme emergency conditions with the approval of the park superintendent.

Restoration and mitigation

7. Resource managers preplan to avoid fire accidents. Extreme conditions or sudden changes in weather do not always allow the prevention of damage to resources that may require emergency stabilization and rehabilitation. Measures to initiate rehabilitation are developed in consultation with specialists such as archeologists, hydrologists, plant ecologists, and wildlife managers who help identify treatments and write the short and long-term rehabilitation plan following a fire. They then help implement and monitor plans which may include cutting stumps, brushing handlines, recontouring drainage lines, removing trash, planting in burned areas, installing erosion control devices, and felling hazardous trees. Specific mitigative measures are outlined in Chapter II.

Education and communication

8. Communication is key to implementing the many components of a fire program. Methods of coordinating fire activities and notification of all park staff, concessionaires, neighbors and the public is being updated to improve fire-fighting efficiencies and public safety. Cooperation with neighboring landowners and agencies is in place under the existing FMP. Fine-tuning these park-neighbor agreements to allow suppression at natural or man made boundaries is expected to improve firefighter safety and reduce damage to soils and vegetation. Updating these agreements is an on-going process and will be pursued when staff resources are available. Further development of these agreements with state agencies moves the park towards interagency cooperation, a goal of the Federal Fire Policy. Agreements with Mexico and surrounding state agencies will help provide cohesive fire management of approximately 2.1 million acres of protected Chihuahuan Desert lands.

Unique to Alternative C

Research burns

Research burns are prescribed burns used to obtain specific information about fire effects on particular species or habitats, and to record fire dynamics under prescribed burning conditions. Collection of this information begun in the later 1970s and early 1980s, will guide restoration of particular habitats such as grasslands, improve understanding of how to stimulate or maintain diversity of species, to maintain or improve habitat for listed species, guide reintroduction of fire into heavily fueled areas, and increase

understanding of how to use fire in the control of exotic plant species. Data collection priorities are understanding how to introduce fire in sensitive habitats where park values are at greatest risk.

Analysis of Environmental Impacts

Analysis of the effects of the three FMP alternatives was applied to the following eight impact topics.

Impact topic (1): Life and Property

Fire is an effective tool for reducing hazard fuels, but it is also a threat to the public, firefighters, park staff, developed areas, and neighboring properties.

Impact topic (2): Visitor Experience

Fire program activities may result in road closures and deter visitors; conversely some visitors are interested in fire and the post-fire activities offer interpretative opportunities.

Impact topic (3): Local Economy

Fire events provide business for local merchants and firefighters but may deter visitors. More routine fire events are likely to be better for the local economy than a single large high-severity fire.

Impact topic (4): Vegetation

Fire will benefit many species and habitats in the long-term but will kill and injure some plants in the short-term. Sensitive habitats require special consideration in fire planning. Allowing large-scale fire in wilderness maintains desirable mosaic patterns of burned and unburned vegetation. Fire can lead to increases in fire adapted exotic plants but can also contribute to their control.

Impact topic (5): Threatened and Endangered Species

Protecting federally listed species from fire require careful precautions to safeguard individuals, populations, and their habitats over the long-term; fire however, may be essential to maintain habitats.

Impact topic (6): Cultural Resources

Fire may help reduce hazard fuels and maintain historic views but can also damage and destroy structures, landscapes and artifacts.

Impact topic (7): Watershed Effects

Fire can remove vegetation and organic matter contributing to erosion and debris flows.

Impact topic (8): Resources for the Park Fire Program

The action alternatives propose more routine fire program activities and more natural ignitions; fighting fires safely, meeting monitoring, planning and compliance needs necessitates additional training, staff and resources.

All of these proposed fire management strategies would result in some short-term adverse effects, such as the death of individual plants and animals and disruption of habitat. Alternative A in allowing fuels to continue to increase across the park, may result in the greatest damage from high-severity fire under extreme weather conditions. An outcome of such fire in the Chisos may be the removal of soil organic matter initiating watershed erosion, destruction of soil seed sources slowing revegetation, and suppression activities damaging unidentified archeological sites and possibly converting woodlands and forests to shrubland or grassland communities. Alternative B may reduce fuels at a greater rate, but in allowing more fire also increases the injury rate to plants and animals, and exposes firefighters to risk more frequently, and could result in undesirable unintended consequences. Outcomes over the longer-term are unknown but the threat of high-severity fire in the Chisos is reduced. Alternative C seeks to reduce fuels

over a longer-time frame than Alternative B but sooner than Alternative A and reduce the potential for undesirable unintended consequences.

Resource managers understand that weather and climate dynamics may mean an extreme fire event or events could occur before the proposed management policies under Alternative B or C can realize their expected benefits. Should a high-severity fire occur under extreme conditions, it is possible that all alternatives will have the same outcomes – particularly in the Chisos Mountains.

Recognizing that fire is a natural feature in the Big Bend landscape, the park proposes under the preferred alternative, Alternative C, to reintroduce natural fire immediately where it is safe to burn, reduce fuels cyclically through prescribed burns to allow natural ignitions in the back country, expand protection for developments and cultural resources, and to learn more about fire effects and dynamics in sensitive habitats through research burns, fire effects monitoring or prescribed burns conducted in similar fuels and vegetation in other areas. Suppression over many years has translated into a liability for the park that is being addressed in this EA

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Chapter I : Introduction

Big Bend National Park is named for its location on the deep 100-mile-radius bend in the Rio Grande River in southwest Texas (Figure I-1). In authorizing a park in 1944, Congress recognized the area's rich biology, geology, cultural history, and outstanding recreational opportunities. International recognition of the park's resources came with a UNESCO Man and the Biosphere Reserve designation in 1976.

Archeological sites dating back 10,000 years testify to the significance of the region to humans during prehistorical times. European efforts to colonize this area began in the 1500s heralding tumultuous times as Europeans, Mexicans and Native Americans fought for control until the late 1880s. The park now hosts an average of 300,000 visitors annually from across the United States and around the world. Visitors seek respite, scenic beauty, and recreational opportunities in the 801,000 acres of mountains, desert, and river, more than half of it proposed wilderness.

Purpose for Action

The purpose of this EA is to implement an improved fire management plan (FMP) for Big Bend National Park. The park is required to review its FMP and make appropriate changes on an annual basis with an update every five years. The approved plan will provide a framework for making fire-related decisions and serve as an operations manual. Updating the 1994 plan allows changes in fire policy, fire knowledge, burn results, and revisions in NPS policies to be implemented in practice. By incorporating changes in fire ecology, knowledge of fire effects and firefighting techniques, the FMP will better protect people, property and resources within the park. The proposed FMP provides an important transition from the suppression era and the high-severity fires seen throughout the West to an era of allowing natural fires to shape and structure the parks vegetation as it had historically.

Need for Action

Current resource managers acknowledge four major challenges in managing vegetation at the park. The first is greatly increased fuels in forest and some woodlands increasing risk from high-severity fire. The second is an invasion of fire adapted nonnative species which threaten to displace native species primarily along the riparian corridor and drainages and potentially alter the fire regime from small low frequency fires to frequent, larger scale events. The third is altered fire patterns from historical overgrazing and suppression particularly in lowland desert grasslands. And the fourth is the prioritizing and meeting these challenges requires a significant shift in management direction for training, funding and support of project monitoring and evaluation, and commitment to implementing new policies over the long-term.

There has been no major fire in the Chisos Mountains for over 100 years. This may be part of a natural cycle as Moir estimated a conservative fire return ranging from 70 years using fire-scars in tree rings (1982). Early biological surveys described grasslands covering the Chisos Mountains (Schmidley, 2002) suggesting low-intensity, frequent grass-carried surface fires that would have maintained open woodland. Grazing since the 1880s, drought, and suppression till present day, have changed fire patterns altering historical vegetation types. In the absence of fire, fuels have accumulated increasing the risk of widespread, high-severity fire that would greatly impact the mountain woodlands and forests. Fire frequency and effects in low desert grasslands and desert scrub within the park is not well documented or understood. Large acreages of lands degraded by overgrazing may potentially be restored with careful use of fire, cycles of above average precipitation, and water retention techniques to aid grass seedling establishment. The proposed fire research program would build a platform for understanding how restoration might occur in lowland grasslands, endangered species habitats, and where nonnative plants have invaded. The 118-mile riparian corridor has dense stands of saltcedar and giantreed, with Bermuda grass and buffelgrass becoming well established along shorelines and drainages. Increased fire to benefit natural ecosystems may lead to expansion of nonnative species without accompanying commitment to post-fire control measures.

Assessments of the park in the 1940s and 1960s suggested that fire be reintroduced to counter changes in vegetation resulting from suppression and grazing. Staff shortages, limited resources and cautious administrators led to continued suppression of most natural ignitions under earlier FMPs (1973, 1978). A prescribed fire program began in 1980 to protect developments burned 1539 acres in 24 years. Two prescribed fires to develop defensible space and reduce fuels that did occur in backcountry, escaped, leading to new prescriptions under the proposed FMP to ensure greater safety. Over the same 24-year period there were 239 lightning caused fires, which burned 19,021 acres suggesting a need to allow more natural fires where they occurred historically.

The current 1994 FMP has two fire management units. All developments, historic structures, a one-mile buffer along the border, the Chisos and northwestern section bounded by US highway 385 and State Highway 118 are contained within a suppression zone. The park sought to prevent fire from leaving park boundaries and impacting neighboring landowners and valued resources. Prescribed burns and non-fire treatments were permitted. The rest of the park allowed wildland fire but it was rarely permitted to burn leading to increases in fuels and continued changes in vegetation structure and species.

The need for the current EA is to update the FMP to comply with NPS Director's Order #18: Wildland Fire Management (DO-18 1998) which requires each park with vegetation capable of burning to develop a FMP that considers safety for people and property and is responsive to the park's natural and cultural resource objectives. Completion of the proposed FMP will meet these requirements and provide direction for all fire related programs at the park by analyzing three fire management alternatives. Park staff intend that fire be carefully managed to maximize its benefits and minimize its dangers.

Policies and Regulations

The following regulations and guidance documents relate directly to the completion of a FMP and EA for the park.

National Environmental Policy Act (1969 NEPA) – The purpose of NEPA is to encourage productive and enjoyable harmony between humans and the environment; to promote efforts, which will prevent or eliminate damage to the environment and stimulate the health and welfare of mankind; and to enrich the understanding of the ecological systems and natural resources important to the Nation. NEPA requirements are satisfied by successful completion of an EA.

Director's Order –12 (DO-12, NPS 2001) – DO 12 is the NPS guidance for Conservation Planning, Environmental Impact Analysis, and Decision Making. DO-12 states the guidelines for implementing NEPA according to NPS regulations. DO-12 meets all Council on Environmental Quality (CEQ) regulations for implementing NEPA. In some cases, NPS has added requirements under DO-12 that exceed the CEQ regulations.

NPS Organic Act of 1916 – Congress directed the U.S. Department of the Interior and NPS in the Organic Act to manage units, “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” (16 U.S.C. § 1). Congress reiterated this mandate in the Redwood National Park Expansion Act of 1978 by stating that the NPS must conduct its actions in a manner that will ensure no “derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress” (16 U.S.C. § 1 a-1).

Director's Order-18 (DO-18, NPS, 1998) – DO-18 is the NPS guidance for Wildland Fire Management, which states that, “every NPS unit with burnable vegetation must have an approved Fire Management Plan.” DO-18 defines what an approved FMP must include, stressing that “firefighter and public safety is the first priority” and promoting “an interagency approach to managing fires on an ecosystem basis across

agency boundaries.” Procedures for completion, review, approval, and required contents for FMPs are provided in Reference Manual-18 (RM-18). Until an FMP is approved, NPS units must take an aggressive suppression action on all wildland fires.

Policies affecting impact topics

1. Life and Property

NPS Management Policies (2001) Section 4.5– defines how the NPS will meet its park management responsibilities under the 1916 NPS Organic Act. The NPS recognizes that the presence as well as the absence of fire influences park landscapes, ecosystems, and operations. Management considerations are summarized below:

- parks with vegetation capable of burning will prepare fire management plans and address funding and staffing required by fire programs
- fire management programs will meet resource management objectives while ensuring protection of life and property
- fire plan development will include the NEPA compliance process and necessary collaborations with outside parties
- fires in vegetation are to be classified as wildland or prescribed fires and managed according to considerations of resource values, safety, and cost
- prescribed fires are ignited to achieve resource management goals and closely monitored to determine whether they successfully meet objectives
- parks lacking approved plans must suppress all wildland fires using methods that are the most cost effective while causing the least impact
- suppression in wilderness will be consistent with the “minimum requirement” concept

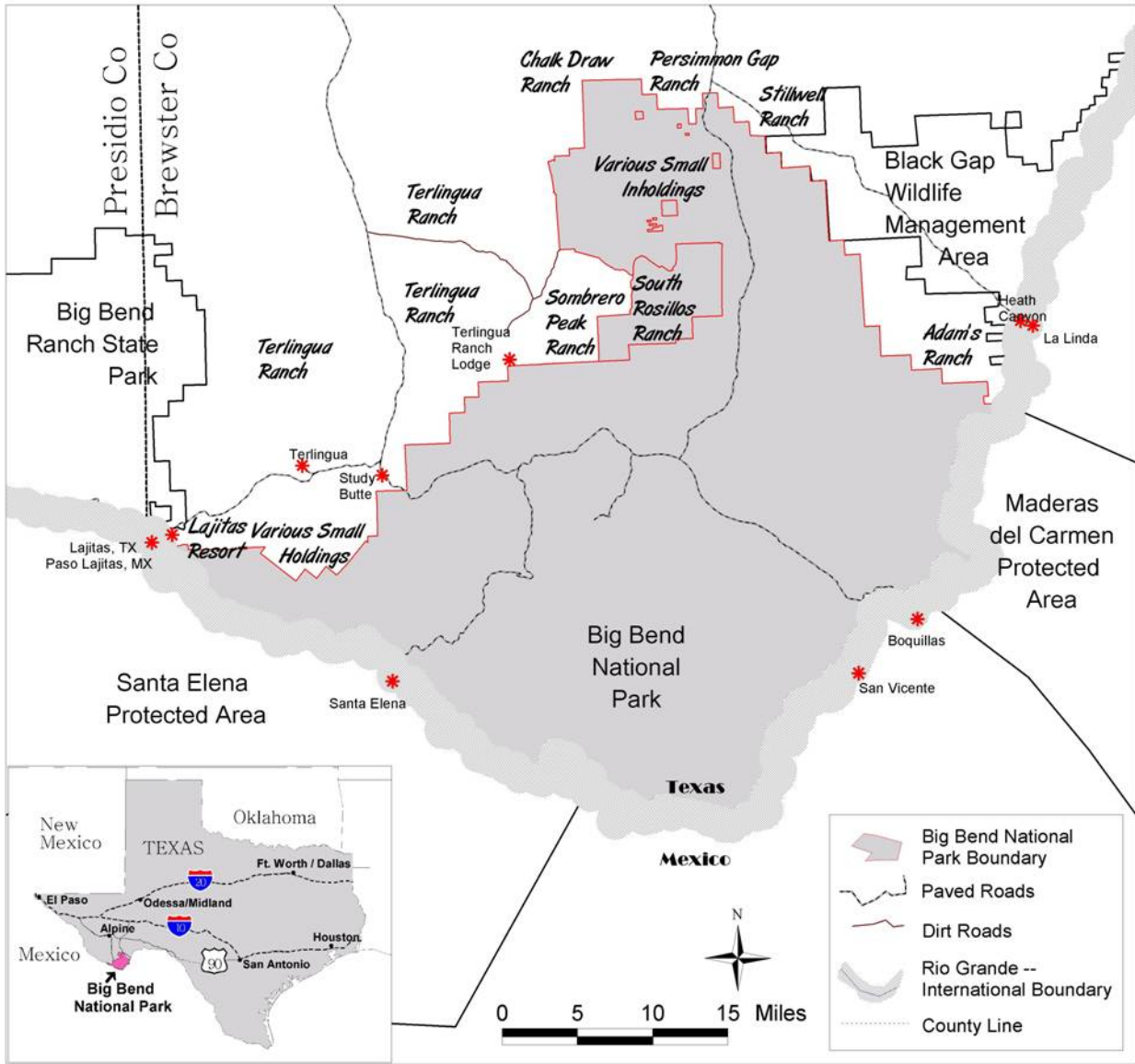


Figure I-1 Location of Big Bend National Park.

2. Preservation of Visitor Experience

NPS Management Policies (2001) – defines how the NPS will meet its park management responsibilities under the 1916 Organic Act.

Clean Air (as amended 1990) – includes national ambient air quality criteria; states that federal land managers have an affirmative responsibility to protect air quality related values from adverse impacts.

National Park's and Recreation Act (1978) - requires park management to preserve the park's resources by considering how development affects public enjoyment, identifying visitor carrying capacity; and proposing any boundary changes.

3. Local Economy

NPS Management Policies (2001) -defines how the NPS will meet its park management responsibilities under the 1916 Organic Act.

4. Vegetation

NPS Management Policies (2001) -defines how the NPS will meet its park management responsibilities under the 1916 Organic Act.

Executive Order 13112: Invasive Species (1999) – outlines definitions, guides management, monitoring and restoration guidelines for native vegetation.

Wilderness Act (1964) – requires all area of potential or designated wilderness be managed to maintain natural conditions.

5. Threatened and Endangered Species

Endangered Species Act/ Section 7 – provides for listing and protection of endangered and threatened species and their critical habitat; requires consultation under Section 7 if any listed species may be adversely affected.

Texas Department of Game and Fish – maintains state list of endangered and threatened, and sensitive species.

6. Cultural Resources

Archeological Resource Protection Act (1979) - provides for the protection of archeological resources on public lands.

American Indian Religious Freedom Act (1978) -protects access to sites, use and possession of sacred objects and freedom to worship through ceremonials and traditional sites.

National Historic Preservation Act/Section 106 – provides for the identification and protection of historic sites and structures.

Archeological Resources Protection Act (1979) - provides for the protection of archeological resources on public lands.

Executive Order 13007: Indian Sacred Sites (1996) – provides for the protection of Indian sacred sites.

Executive Order 11593: Protection and Enhancement of the Cultural Environment (1971) - preservation and enhancement of non-federally owned sites, structures and objects of historical, architectural or archaeological significance.

Historic Sites Act (1935) – provides for the preservation of historic sites, buildings, and objects of national significance for the inspiration and benefit of the people of the United States.

National Historic Preservation Act (1966) – a federal program to preserve historic properties.

NPS Director's Order #28 – defines how the NPS will meet its park management responsibilities under the 1916 NPS Organic Act to conserve scenery, natural and historic objects, and wildlife to provide for the enjoyment of future generations.

NPS Management Policies (2001) –_defines how the NPS will meet its park management responsibilities under the 1916 NPS Organic Act.

Native American Graves Protection and Repatriation Act (1990-NAGPRA) - provides a process for museums and federal agencies to return certain Native American cultural items to their descendants and affiliated tribes.

7. Watershed Effects

NPS Management Policies (2001) -defines how the NPS will meet its park management responsibilities under the 1916 NPS Organic Act.

Executive Order 11990:Wetlands Management (1977) – provides for the protection of wetlands.

Executive Order 11988 Floodplains Management (1977) – provides for the protection of floodplains.

Clean Water Act and Section 404 regulations – provides for the protection of wetlands and waters of the U.S.

8. Resources for the Fire Program

NPS Management Policies (2001) -defines the values the NPS must protect under the 1916 NPS Organic Act. Federal funding is available for emergency firefighting and for fuels reduction on a competitive basis. As the park moves to allowing more wildland fire on a routine basis and carefully designed and monitored research burns, the funding options are less clear.

Other Plans, Policies, and Actions

Continuity between the plans and policies already in effect at the park must be maintained in developing this EA and FMP.

The General Management Plan (1981, draft 2003), the Statement for Management (1992), the Resources Management Plan (1988), and the FMP (1994) determine how Big Bend protects its resources. All plans recognize objectives directly related to comprehensive fire management. These documents emphasize the need for research to support management of natural resources, management across ecosystems, which requires the cooperation of private, state and Mexican landowners, and the preservation and interpretation of the park's many scenic geological, biological, cultural and historical features. The provisions in the proposed fire management plan and the mitigation measures listed in this EA are consistent with addressing these directions. In addition the IDT has examined the Federal Wildland Fire Management Policy (1995, Review and Update, National Interagency Fire Center, 2001) to ensure policies concur with national guidelines.

Contributors to the Plan

Five broad groups of people prepared the information for this EA and are working on the FMP. The groups are introduced below and give more detailed coverage in Chapter V (Consultation and Coordination).

- *Interdisciplinary Team (IDT)*: The IDT is composed of NPS staff who are ultimately responsible for carrying out the plan. The staff has expertise in natural and cultural resources, fire operations, park administration, and visitor services. The Big Bend team also included a partner from the University of Arizona who served as overall editor for the EA.
- *Other Agency Cooperators*: Development of the plan included consultation with U.S. Fish and Wildlife Service, and Texas Parks and Wildlife on threatened and endangered species. The Black Gap Wildlife Management Area and Big Bend Ranch Park are being consulted about fire along park boundaries. The Texas State Historical Preservation Office was consulted about cultural resources.

- *Tribal Governments:* The seven tribes affiliated with the park are Apache Tribe of Oklahoma, Blackfeet, Comanche Tribe of Oklahoma, Kickapoo Traditional Tribe of Texas, Kiowa Tribe of Oklahoma, Mescalero Apache Tribe, and Ysleta Del Sur Pueblo. Tribes were not informed within the official comment period because of confusion about which tribes were affiliated with the park. Research by the park Tribal Liaison Officer, and staff in Santa Fe expanded the original list from 3 to 5 and finally to 7 tribes. Each will receive a copy of the draft EA and invited to comment on the alternatives.
- *Mexican Preserves:* The managers of the protected areas, Maderas del Carmen in the state of Coahuila, and Canyon de Santa Elena in the state of Chihuahua received notice of the park's planning process and were invited to participate. No comments were received. The preserve managers will continue to be invited to participate in planning meetings and efforts will be made to ensure they can attend meetings that jointly benefit management and operations of the park and preserves.
- *Interested Public:* The written comments of people who attended public scoping meetings, neighbors, and other interested members of the public have been considered during the development of this EA and FMP.

The Planning Process

Eighteen park staff members met on December 11-12, 2002 to discuss project objectives, issues, alternatives, NEPA's mandatory topics and the NPS Intermountain Regional Office Environmental Screening Form (IMRO ESF). An interdisciplinary team (IDT) from the park assisted in developing public scoping materials and hosting two public open houses on 26 and 27 June, 2003 at Alpine and Study Butte, respectively. The IDT team contains expertise in fire ecology and operations, natural resources including wildlife and vegetation management, cultural resources, and interpretation. As the EA was developed the team also sought assistance in Geographic Information Systems (GIS), hydrology, soils, and NPS law both within, and outside the park.

Goals and Objectives

The IDT developed six goals and objectives for the fire management plan at its December 11-12, 2002 meeting at the park and are listed in Table I-1. In identifying these goals, the IDT recognized that weather conditions and available resources may mean that the area burned can differ from the original plan. The team also stress the need for clearly identified goals for prescribed burns but flexibility to arrange prescribed burns when weather and resources permit.

Table I-1: Goals and Objectives of the Big Bend Fire Management Plan

Goal 1: Protecting people and property is the highest priority of every fire management activity.

Objectives to achieve goal:

- Prevent injury to the public, staff, and fire personnel.
- Reduce fuels that could adversely affect life and property using prescribed fire, mechanical or other non-fire fuel reduction methods.
- Prevent human-caused wildland fires through public education.
- Maintain safe egress from all areas of the park in case of fire.

Goal 2: Apply wildland fire use, prescribed fire, non-fire fuel reduction measures, and fire suppression to accomplish natural resource management objectives.

Objectives to achieve goal:

- Determine the natural range of variability of the fire-return intervals.
- Determine desired conditions and condition classes for vegetation categories.
- Use fire as a restoration tool or as a maintenance tool.
- Monitor results of fire program activities and adjust management based on new knowledge.
- Where possible, ultimately allow fire to resume its natural role in park ecosystems.

Goal 3: Apply wildland fire use, prescribed fire, non-fire fuel reduction measures, and suppression to accomplish cultural resource management objectives.

Objectives to achieve goal:

- Use prescribed fire or non-fire fuels reduction tools to reduce fuels around sensitive sites.
- Restore and/or maintain cultural landscapes.
- Take advantage of surveying opportunities during and after fire operations.

Goal 4: Minimize unacceptable environmental impacts of fire program activities on natural and cultural resources.

Objectives to achieve goal:

- Properly plan each activity and conduct pre-action surveys.
- Carefully determine prescriptions.
- Suppress fires that fail to meet management objectives.
- Use minimum impact suppression tactics [MIST].
- Confer with resource advisors.

Goal 5: Cooperate fully with adjacent land management agencies and private landowners in the management of fire near park boundaries.

Objectives to achieve goal:

- Maintain communication and educate the neighbors about the fire program.
- Formalize relationships and conduct joint fire management activities with neighbors.

Goal 6: Coordinate fire activities with all park divisions, concessionaires, and the public.

Objectives to achieve goal:

- Maintain multiple lines of communication with all parties, in particular using the daily briefing sheet, website, and interpretive programs.
- Bring together structural and wildland fire planning operations.
- Incorporate appropriate fire management tasks into all park divisions.

Environmental Issues

This EA assesses the environment effects of three FMP alternatives proposed to meet the need and purpose of the new FMP. A NPS/UA interdisciplinary team (IDT) identified issues based on staff experience and knowledge of the park, application of the NPS Intermountain Region Environmental

Screening Form (IMRO ESF), and from public comments. Issues are problems, questions, concerns, or even benefits that could be caused by one or more of the alternatives. The complete list is retained as Appendix A. From this list the IDT then grouped issues into impact topics – issues where there is likely to be a greater than negligible impact despite mitigative measures. The eight impact topics derived from the discussion are listed below in Table I-2. The IDT also addressed the NEPA list of mandatory topics and compiled Table I-3 to show how they apply to Big Bend National Park. Those topics that do not apply to the park have been identified in the table and reasons given for their dismissal from further consideration in this EA. In November 2003, these eight impact topics were reviewed and amended with advice from NPS, state and regional representatives assisting with the development of park EA. Cooperative agreements with neighbors to manage fire along park boundaries, formerly a separate impact topic, were transferred to life and property, and exotic plants and unique habitats included with vegetation. Two new topics were suggested. These were watershed effects, and resources for the fire program. There are still eight topics but they include more considerations than the original determinations of the IDT.

Impact Topics

Safety is the first priority of any FMP and addresses the specific concerns of life and property (impact topic 1). Because fire may cross park boundaries, the impact on neighbors will also be considered under this topic. The park exists to provide a range of educational, recreational and scenic opportunities to the public, making visitor experience a key consideration (impact topic 2). Visitors are drawn to the park's cultural resources, including historic sites and landscapes, and these must be considered when managing for fire (impact topic 6). The parks' attractions and remote location make Big Bend National Park an important tourist destination in southwest Texas, and significant to the local and regional economy (impact topic 3). The park fire program exists because of the nature of the vegetation and its flammability. The park's botanical diversity, special plant communities and wilderness, together with the invasiveness of some exotic plants, pose distinct management challenges (impact topic 4). Many visitors travel to the park to see threatened and endangered wildlife found in few other NPS units (impact topic 5). Visitors particularly value the Chisos Mountains, which may experience impacts to the watersheds from widespread, high-severity fire (impact topic 7). In addition, the IDT recognized that additional resources were essential to allow the fire program to undertake more routine operations ensuring the objectives under all the impact topics were addressed over the long-term (impact topic 8).

Table I-2 Impact Topics

Impact Topic	Key Features
1. Life and Property	Fire is an effective tool for reducing hazard fuels, but it is also a threat to the public, firefighters, park staff, developed areas, and neighboring properties.
2. Visitor Experience	Fire program activities may result in road closures and deter visitors; conversely some visitors are interested in fire and the post-fire activities offer interpretative opportunities.
3. Local Economy	Fire events provide business for local merchants and firefighters but may deter visitors. More routine fire events are likely to be better for the local economy than a single large high-severity fire.
4. Vegetation	Fire will benefit many species and habitats in the long-term but will kill and injure some plants in the short-term. Sensitive habitats require special consideration in fire planning. Allowing large-scale fire in wilderness maintains desirable mosaic patterns of burned and unburned vegetation. Fire can increase exotic plants and also be used as a control tool.
5. Threatened & Endangered Species	Fire could directly kill or injure listed plant and animal species, and alter their necessary habitat conditions, but could also facilitate habitat improvement and reproduction for fire-adapted plants and wildlife.
6. Cultural Resources	Fire may help reduce hazard fuels and maintain historic views but can also damage and destroy structures, landscapes and artifacts.
7. Watershed Effects	Fire can remove vegetation and organic matter contributing to erosion and debris flows.
8. Resources for Fire Program	The action alternatives propose more routine fire program activities and more natural ignitions; fighting fires safely, meeting monitoring, planning and compliance needs necessitates additional training, staff and resources.

The Council on Environmental Quality guidelines state, “(m)ost important, NEPA documents must concentrate on the issues that are truly significant to the action in question, rather than amassing needless detail.” (CEQ 1978). The following impact topics and issues specified in DO-12 or identified by park staff were carefully considered. “Topics retained for consideration” outlines issues central to the analysis of alternatives, and “Topics not retained for consideration” outlines reasons for dismissal from this EA.

Table I-3: NEPA Mandatory Topics

Category	How addressed
<hr/> <i>Topics retained for consideration throughout the EA</i> <hr/>	
Plans and Policies	Relevant plans and policies are listed above in this chapter.
Ecologically Critical Areas	These issues are addressed under impact topic (4) as unique habitats and as habitat for endangered species under impact topic (5).
Federally Listed Species	The park is consulting with U.S. Fish and Wildlife Service on a Biological Assessment (BA) that analyzes effects on three species, two animals and one plant likely to be adversely affected by Fire Management Activities. The USFWS will issue a Biological Opinion once that determination is completed. In this EA, Chapter III provides background and Chapter IV summarizes the BA's analysis for federally listed species under impact topic (5).
Geohazards	Fire can alter watershed processes, which may affect erosion and flooding. High fuel loads in the Chisos increase the potential for high-severity fire, which burns soil organic matter creating hydrophobic soils and could lead to erosion and debris flows. This issue is addressed under impact topic (7) watershed effects.
Important Cultural Resources	The park has produced a Cultural Resources Component (CRC) analyzing cultural issues. In this EA, Chapter III provides background and Chapter IV summarizes the CRC's analysis; the summary matrix from the CRC is attached to this EA as Appendix C. Seven affiliated tribes with historical and/or contemporary ties to the park were consulted. Cultural resources are covered under impact topic (6).
Life and Property	These highest priority concerns are addressed under impact topic (1).
Socioeconomics	Fire may have beneficial effects on local businesses and seasonal firefighters. The public may be deterred from visiting the park during fire or after fire or they may be intrigued. The closure of the international border has limited economic and social exchanges to the detriment of both the US and Mexico. Potential effects are addressed under local economy, impact topic (3).
Wetlands and Floodplains	NPS is required to address effects of fire management actions on the Rio Grande floodplains (E.O. 11988) and major drainages. While there is significant burnable vegetation in the floodplain and rivers the effect of fire will be greatest on vegetation with minimal effects on water quality and quantity. Wetlands have been severely altered by mining, agriculture and grazing. Fires there will have minimal effects to water quality and quantity. Upland springs are addressed under impact topic (4) and Gambusia ponds under impact topic (5). Wetlands and floodplains will be dismissed as a separate impact topic because we believe that effects will be adequately addressed under impact topic (4).

Category	How addressed
<i>Topics dismissed from further consideration in this EA.</i>	
Air Quality	Big Bend NP is in a class I airshed. Fires cause short-term declines in air quality but are a minor source of pollution in the area. The park will meet Texas Commission on Environmental Quality's (TCEQ) regulatory standards and guidelines for all prescribed burns. In addition, emissions from wildland and prescribed fires are not regulated under federal or Texas state law unless there will be a permanent or long-term effect on air quality (Sandberg et al. 2002). For these reasons air quality was dismissed from further consideration in this EA.
Energy Requirements and Conservation	Vehicle use to support fire management activities consumes fuel. A return to more natural fire processes saves resources consumed fighting fire. Because energy consumption is not a factor that affects selection of fire management strategies, the impact topic was dismissed from further consideration.
Consumption of Natural or Depletable Resources, and Conservation Potential	Fire and fire management activities consume renewable natural resources such as vegetation and water and non-renewable vehicle fuel. Consumption of vegetation is discussed under all impact topics. Because consumption of other resources is not a factor that affects selection of fire management strategies, this impact topic was dismissed from further consideration.
Urban Quality	Big Bend National Park is located within two sparsely populated rural counties. There are no urban centers abutting park borders, and nearby centers are located in sparse vegetation and unlikely to be directly impacted under the fire program. Therefore this impact topic was dismissed from further consideration.
Socially or Economically Disadvantaged Populations	There are no impacts predicted to fall predominantly upon disadvantaged populations. Big Bend National Park is located in sparsely populated Brewster and Presidio counties with fire operations benefiting small merchants and local firefighters. Therefore, this impact topic was dismissed from further consideration.
Prime and Unique Agricultural Lands	This impact topic was dismissed from further consideration because these lands are not found within the park, per Natural Resource Conservation Service, draft GMP 2003.
Land Use Conflicts	There are no land use conflicts predicted under the proposed alternatives and this topic was dismissed from further consideration in this EA.
Sacred Sites	There are no currently known sacred sites within the park. The issue is dismissed from further consideration in this EA but an open door policy remains to address tribal needs as they arise.
Indian Trust Resources	There are no Indian Trust Resources in Big Bend National Park, therefore this issue was dismissed from further consideration in this EA.
Water Quality	The Rio Grande is the major water body in the park. Water quality is greatly influenced by agricultural activities upstream over which the park has little influence, therefore this topic was dismissed from further consideration in this EA.

Chapter II : Fire Management Alternatives

Introduction

This chapter presents the range of fire management alternatives developed by the IDT, describes those alternatives that meet the park's needs, and justifies excluding other alternatives. The IDT developed the alternatives considering park policies, fire history within the park, fire literature, and experience and expertise of team members. Core elements included safety, ecology, public perceptions, cost-effectiveness, developing a fire database for the park, and drawbacks and benefits of proposed actions over the long-term. The limited public response during the scooping period supported the park preferred and environmentally preferred Alternative C. Each of the alternatives requires comparison with the current management direction, the no-action alternative, Alternative A.

Development of Alternatives

The IDT initiated possible alternatives using their experience, existing park plans, National Park Service Policies, the National Fire Plan and Federal Wildland Fire Management Policy, input from federal and state agencies, together with comments from the public and cooperators from the University of Arizona, School of Renewable Natural Resources. A small number of comments were received during two public open houses. Six members of the public and seven staff attended the first meeting at Sul Ross State University of 26 June 2003. The fire management officer and fire ecologist presented the alternatives and their implications and answered questions. The second meeting at the Study Butte Community Center on 27 June 2003 was supported by four staff and attracted three people. The public favored Alternative C that gradually increased wildland fire use based on research results. One member of the public supported Alternative B or full wildland fire use, if hazard fuels were sufficiently reduced. Three written comments were received supporting Alternative C.

Resource Analysis

Chapter III provides the environmental background for the alternatives introduced in this chapter. Fire history, fire ecology, and prescribed burn program results are summarized here. This background is needed to understand historical fire frequency and how managers and potential impacts of fire management options.

Fire History and Ecology

The effects of fire were investigated on higher elevation vegetation in the Chisos, and lower desert scrub and grasses. Researchers have sought to identify pre-European fire frequency by identifying fire scars in tree rings. Moir (1982), in reconstructing fire history of the Chisos Mountains, found 10 tree-scarring fires in Boot Canyon and the Southeast Rim with fires between 9 and 60 or more years apart conservatively estimating a fire-return interval of 70 years. In a study of 63 woodland sites throughout the southwest from 1700, Swetnam and Baisan noted fire return intervals of 1-89 years with a mean of 25 years (1996). In the Guadalupe Mountains Ashlstand (1981) noted mixed conifer forest averaged fire every five years from 1554-1842. In an effort to clarify fire trends for this region, Helen Mills at Yale University is currently undertaking a comparative study by of the Davis, Chisos and the Sierra Del Carmen Mountains to reconstruct historic vegetative structure and fire frequency. When resource managers know the historic range of variability for fire, they can identify restoration processes for small changes, or accept a type conversion.

The last sizable fire in the Chisos was in 1903. Lack of fire is attributed to grazing (from 1880s to 1940s,) drought (in 1890s and 1950s especially) and suppression (since grazing) which promoted shrub growth over grasses. That grasses once carried fire into the Chisos is suggested by government biological surveyor Vernon Bailey, who wrote in 1901, "Luxuriant grass covers almost the whole of the

mountains....” and “Oaks, pines and junipers are the dominant trees...” suggesting frequent low-intensity fire, which kept woodlands open (Schmidley 2002:350). The current inflammability despite high fuel loads may reflect the topography of sheer cliffs, talus slopes and rocky terrain. The change of carrier fuels in forest areas from grasses to leaf litter, ladder, dead and downed fuels and small trees, will mean hotter fires, and may hamper efforts to maintain burns within prescriptions (Fule et al. 2004). The abundant high desert grasses noted by the surveyor Bailey, have taken 60 years without livestock to recover and could carry landscape scale fire into higher elevation woodlands and forests. McPherson (1995) estimates fire return intervals in desert grasslands at 7- 10 years, but this may need tempering to local fuel conditions.

The lower elevation desert contains mosaics of shrubs and grasses, and mixes of both depending on landform. Conditions prior to grazing can only be inferred. Mule train owners cut Chino grama, and perhaps tobosagrass to feed their animals (Gomez, 1991). Langford and Gipson described grasses as abundant “knee deep to a horse...only the tallest of the desert plants stood out above it”(1952). Other inferences by Tyler (1975), and Fulcher (1959) referred to periodic abundant grass and although these ranchers lacked scientist’s trained eyes, they knew grass turned cows into money. Overgrazing led to sheet and rill erosion, channel cutting and conversion to more drought tolerant shrubs rather than perennial grasses. Muldavin et al. (2001) examined vegetative changes in the park from 1955 to 1996 on 5 soil types and estimated it takes from 25-40 years for overgrazed sites to recover comparable vegetation, with recovery highly dependent on moisture.

That fire is the primary shaper of these ecosystems is debated. Hastings and Turner (1965) point to the paucity of fire in desert grasslands and the influence of other agents including human activity, climate, soils, drainage patterns, and rodent effect on seed sources – in shaping vegetation. Cornelius (1988) noted that recovery of desert shrubs after fire often exceeds that of dominant perennial grasses. A prescribed burn in 2003 in the northeast of the park however showed a slight increase in grasses within a year. Above average precipitation in the growing season and availability of seed sources may lead to greater establishment of grasses (Drewa and Havstad 2001; McKernan 2003; Muldavin et al. 2001). Fire is expected to be infrequent in these low biomass/ density assemblages where landform shapes moisture conditions (Wondzell et al. 1996). The shrub to grass ratio is dynamic ,shaped primarily by moisture (Muldavin et al. 2001) and then by fire and other agents.

The fire history data and precipitation records from 1948 to 2003, suggest that there is strong relationship between the amount of area burned in Big Bend National Park and the adjacent surrounding area and the amount of precipitation received in preceding years. Grass is the primary carrier fire at the park and the amount of grass increases with increasing precipitation. In drought years grass production is low and any grass grown in a preceding wet period will decrease thus limiting fire spread. However, during wetter periods more grass is produced and the ability of fire to spread increases (Figure II-1). The drought of the 1950’s and the most recent drought of the 1990s resulted in limited burned area. In contrast, the wet period of the last half of the 1980s resulted in several years where more than a 1000 acres were burned. Notably when the 5 year average precipitation exceeds 20.9 inches then the chance of burning more than 1000 acres is greater than 50% (Table II-1). While precipitation is a major driver for vegetation dynamics in desert environments it is also a major driver for fire dynamics. The interrelationship of this two forces of nature is not well understood and will require further study to more fully understand fire’s role in the structure and function of desert vegetation.

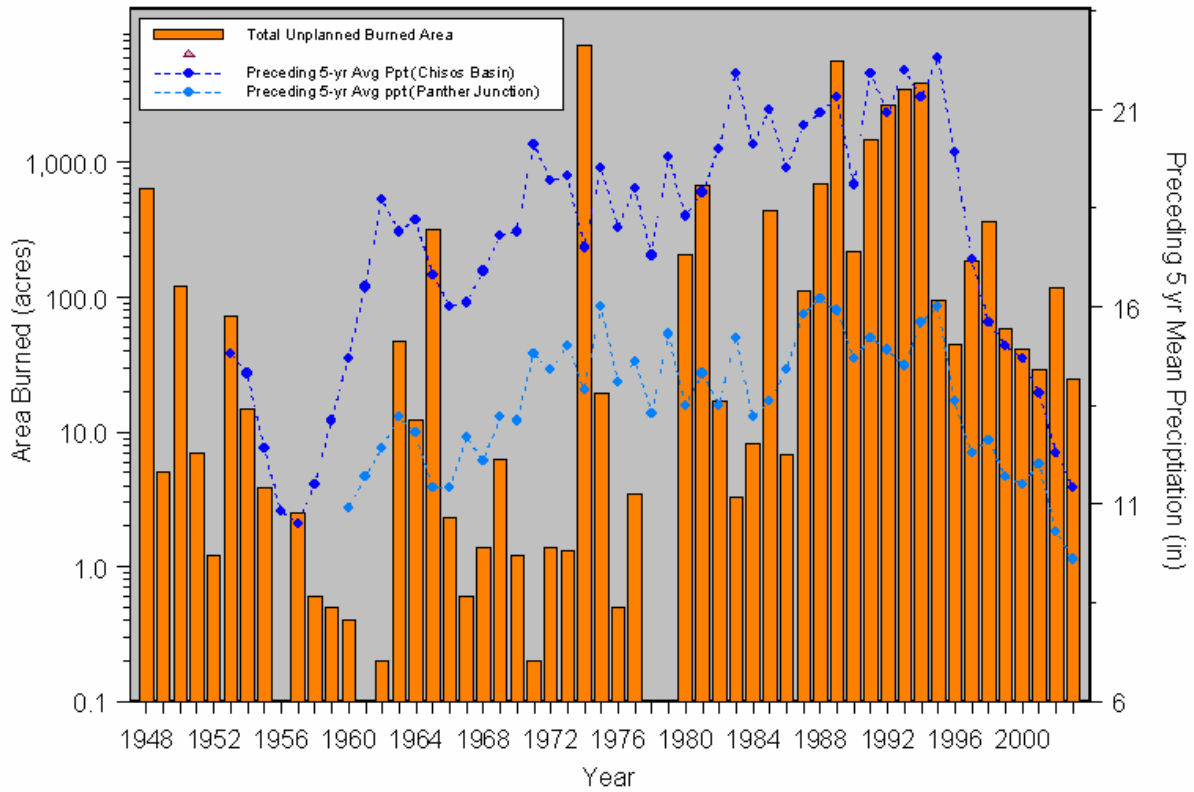


Figure II-1: Plot of the burned area for each fire year from 1948 to 2003 and the preceding 5-yr average precipitation. Each bar represents the total area burned in acres from all unplanned starts (Human and lightning) for that year. The two dotted lines are the preceding 5-yr average precipitation for the Chisos Basin (5400 ft elev.) and Panther Junction (3750 ft elev.) for that year. For example the precipitation value plotted for the fire year 1987, is the precipitation values averaged over the preceding 5 year period, 1982 to 1986.

Table II-1 Probability of occurrence for total burned area for Big Bend National Park and the adjacent surrounding area during any given the 5 year average precipitation preceding any given fire year.

Fire Year Burned Area (acres)	Preceding 5-yr Average Precipitation (inches)		
	<14.0 (n=6 yrs)	14.0 to <20.9 (n=33 yrs)	≥20.9 (n=9 yrs)
<10	57%	47%	11%
10 to <100	29%	28%	11%
100 to <1000	14%	22%	22%
≥1000	0%	3%	56%

Fire History -- 1946 to 2003

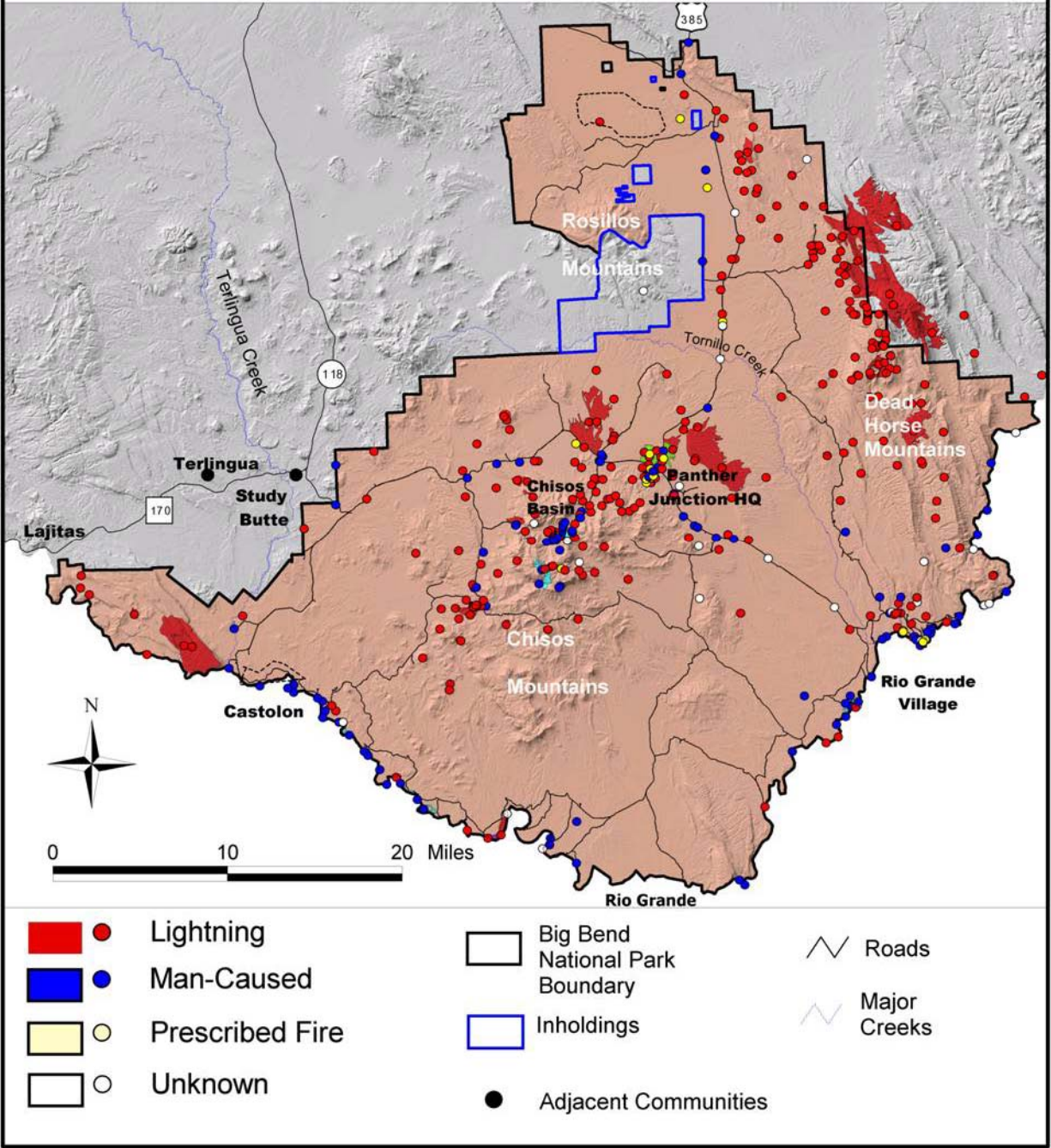


Figure II-2 Location of documented fires at Big Bend National Park

Big Bend Fire Program

Fire's role in maintaining diversity of plant and animal communities was recognized by the NPS as early as 1928 with calls to address the 'fire problem' (Welsh 2002). The need to reduce fuels in Big Bend been recognized for decades (McDougall et al. 1944; Leopold 1963). Authors of the park's three FMPs (1973, 1978 and 1994) concurred with these findings but staff and resource shortages have limited park actions. Prescribed burns since the 1980s addressed some needs outlined in the General Management Plan (1981), Resource Management Plan (1988), and current Fire Management Plan (1994) to reintroduce fire as a step towards reestablishing dynamic Chihuahuan Desert ecosystems. Most fire however, was targeted as prescribed burns around developments where 35% of all fires have occurred from 1946-2003. Since 1980, 31 prescribed burns consumed 1539 acres . While natural fire was allowed during this period cautious managers let few lightning ignitions burn. However, 239 natural ignitions burned 19,021 acres from 1946-2003 suggesting that there are sufficient fuels to support fire. The majority of wildland fires have been small, less than an acre in size (64%) but 9 more recently were >1000 acres. They were preceded by several years of above average precipitation. The challenge facing managers is how to safely introduce fire as fuels continue to buildup in the Chisos increasing vulnerability to high-severity fire under extreme conditions.

Elements Common to All Alternatives

Tools of the fire program

The fire program toolbox consists of suppression, manual or mechanical thinning, prescribed burns and natural lightning ignitions for natural resource use, fuel reduction, and protection of cultural resource and park developments. Human caused fires have always been, and will continue to be suppressed immediately.

Appropriate Management Response (AMR)

AMR is the specific actions taken in response to a wildland fire. Suppression has been the most common response to natural ignitions in the park under the 1994 FMP but AMR recognizes that a number of appropriate responses may be possible for any set of circumstances. Managers weigh many factors in choosing the appropriate response including the resources at risk, fire use objectives, land use, weather conditions, and NPS regional priorities. The decision-matrix under the 1994 FMP (II-4) limited responses to fire events. Possible responses to wildland fire have been increased with a more flexible decision-making process following lightning ignitions under the action alternatives (Figure II-6). The AMR may lead to controlling fire (suppression), confining fire by allowing it to burn to natural boundaries, or containing it with a mix of natural boundaries and suppression actions. The park will continue to suppress any human caused fires with the least damage to people, resources and property. Fires would be monitored daily or more frequently in accordance with the Fire Monitoring Handbook (USDI 2003) and the Wildland Fire Implementation Plan. The park will continuously update information on fire size, location, behavior, smoke dispersal, safety conditions and effects.

Minimum Impact Suppression Techniques(MIST)

Just as AMR guides analysis of appropriate decisions for managing fire, minimum impact suppression techniques (MIST) guides selection of tools for managing fire. Wilderness areas in particular are to be managed in ways that minimize human impacts on the resource. Firelines along natural barriers such as the river, roads, trails, cliffs and talus slopes are sought wherever possible, and disturbance to the landscape, cultural and other resources minimized. Suitable sites for staging areas and spike camps have been located in previously disturbed campsites and developed areas. Agency resource advisors will be consulted prior to implementing management tactics.

Prescribed Fire Program

Prescribed fires are fires intentionally ignited by management. Since the 1980s park managers have used prescribed fire to reduce fuels around developments and to burn debris. Fires take place in specific areas under predetermined conditions identified in specific burn plans. Table II-3 lists the 31 burns covering 1539 acres that have occurred from 1980 to 2004. Naturally ignited fires are most plentiful just prior to summer monsoons from March through May when temperatures are hottest, fuels are driest, and lightning is plentiful, and again in mid to late July. Most prescribed burns are conducted outside the March 1 to July 15 fire season when conditions governing fire spread are less extreme and damage to plants is reduced. Proposed prescribed fires are listed in Table II-2 for reducing fuels around developments and historical sites, protecting habitat of federally listed species, and obtaining research data for restoration of particular species or vegetation assemblages. An estimated 7925 acres will be burned over the next decade to meet resource objectives.

A certified Prescribed Burn Boss will supervise appropriate levels of staffing for each prescribed fire under all three alternatives. Fire behavior and weather will be monitored during all prescribed fires using the NPS Fire Monitoring USDI (2003). Staff recognize that multiple burns are necessary to reduce fuels and change vegetative structure to allow wildland fire to assume its natural role. Annual reviews of prescribed burns allow lessons to be incorporated into plans for future burns.

Non-fire Fuels Treatments

Reducing fuels and creating firebreaks around property and cultural resources requires a degree of precision and containment not always present with prescribed or wildland fire-use. All alternatives allow use of mechanical tools including chainsaws, to remove brush or trees such as saltcedar trees from upland springs. Mowing facilitates reduction of grassy fuels along 110 miles of paved roadsides. Handheld tools may be used in wilderness areas to remove brush from historical sites or for horticultural use around developments. These non-fire treatments will represent a significant portion of the fire program resources under Alternative C until acceptable fuel levels are established around developments and cultural resource sites. The fire program is partnering with other park departments to aid plant restoration efforts and reduce fuels around nominated cultural resource sites.

Wildland Fire Use

Staff want to allow lightning ignitions whenever they remain within prescriptions. Wildland fires can mimic historical fire occurrence and may be the most cost-effective method for reducing fuel loadings to desired levels or condition classes (Table II-2). All alternatives allow natural ignitions within designated areas and within prescriptions. Administrative decisions have resulted mostly in suppression under the current FMP. Wildland fires under the action alternatives are assessed using more flexible decision criteria. Table II-3 lists 239 wildland fires from 1980 to 2004 burning a total of 19,021 acres.

Monitoring

Under all alternatives, pre-fire monitoring is required for prescribed burns to meet cultural resource and natural resource compliance. Monitoring plots are planned for all six vegetation categories to establish baseline information on species, vegetation structure, cover and height. These plots augment research begun in the late 1970s and early 1980s to develop databases that indicate fire effects over the long-term. The need for a research and monitoring program was noted in the 1994 FMP (p. 80-81). Post-burn information allows comparisons with earlier surveys, refinement of current prescriptions, and eventually may provide information for prescriptive fire plans. Post-fire monitoring is proposed for prescribed burns where such data will assist park resource objectives. Most monitoring data will be collected under Alternative C with pre and post-fire monitoring information for all research burns, and post-fire on prescribed burns and wildland fire when staff are available.

Communication and Coordination

Ignitions are reported to the fire office upon sighting and staff determines the cause of fire. All human caused fires are immediately suppressed. A cascade of environmental and administrative criteria are applied to all lightning caused fires to determine AMR. This step-wise process is outlined in II-4 for the current FMP and Figure II-6 for action alternatives. The Incident Commander, Prescribed Fire Boss or Fire Management Officer provide information to the Public Information Officer who disseminates briefs to all departments, to the visitors' centers to alert visitors of road closures or other inconveniences and to surrounding communities. Conditions are posted on the park web site and updated daily. The park proposes to increase communications particularly with the public as more routine fires are expected under the action alternatives, and because fires offer interpretive opportunities. Planned burns will be minimized during usual high-visitation periods of March through May. Fuels will be reduced along well-trafficked routes to reduce unintended fires and suppression applied around buildings and sensitive areas. Coordination with local landowners and managers is ongoing to minimize cumulative fire impacts on the region.

Interagency Communication

Interagency communication is perceived by the IDT as necessary for development of fire plans that conserve and preserve resources across 1.67 million acres of protected Chihuahuan Desert ecosystems. These reserves are Big Bend National Park, Blackgap Wildlife Management Area (Texas Nature Conservancy), Big Bend Ranch State Park (Texas Parks and Wildlife) and two Mexican preserves, Maderas del Carmen in the State of Coahuila, and Canyon de Santa Elena in the state of Chihuahua. In addition to developing agreements that allow for sharing of information, resources, and responsibilities among county (Brewster and Presidio Counties) state, federal and national institutions, the park wants to gradually incorporate more neighboring landowners into the information sharing process. The Fire Management Officer currently serves as liaison for this process. The park perceives long-term benefits from controlling fire at natural boundaries. Arbitrarily drawn administrative, legal or political boundaries having no regard for topography or vegetation potentially subjects fire fighters to unnecessary risks, and damages soils and vegetation through forced suppression boundaries— damage that could be avoided with more sensible control arrangements.

Emergency Plans

Recognition of the fuel loads and the danger of a single road into and out of the Chisos Basin led the park to develop plans for dealing with emergency fire situations (2003). Plans have also being developed for the Chisos high country to minimize the risk of fire from cigarettes and campfires. The Blue Creek fire (1989) and Laguna Meadow fire (1980) both occurred during the very dry pre-monsoon period of March through April, which also coincides with peak visitation in the park. When fire conditions are assessed as dangerous to extreme danger, a ranger is posted at main entrances to hiking trails for up to 10 hours a day to warn hikers and visitors of the danger. There are four main access points to the interlinked Chisos trails; Juniper Canyon, Blue Creek Canyon, Laguna Meadow and Pinnacles Trail. From these main trails Emory Peak, Boot Canyon, Colima Trail, Boot Spring, Northeast Rim and Southeast Rim can be accessed. It is proposed to link the Lost Mine Trail from Kibbe Spring to the Pinnacles Trail to the east and to Pine Canyon in the west. Hiking permits are issued with the fire danger caution attached, and at times smoking and campfires may be banned outside developed areas. The superintendent has the authority to close the backcountry to safeguard life and prevent human-caused fire.

To prepare for fire events in the park, the fire program has identified sites for firelines (bare earth without burnable materials), spike camps and staging camps. Natural firelines are sought and include talus slopes, rocky outcrops, roads and previously developed firelines in the park. Additional firelines will be developed in consultation with resource managers (wildlife biologist, archeologist, plant ecologist or hydrologist) appropriate to the resource being protected. Five sites for staging camps have been identified. Castolon and the Basin have been used in the past. Rio Grande Village campground, Kbar ranch, and San Vicente school area at Panther Junction during summer school vacation could all

accommodate fire crews of up to several hundred people, including the traffic, communications and supplies necessary to handle large fires over three days or for more extended periods (type III incident). Spike camps could be located at Laguna Meadow, South Rim (campsites 1, 3, and 4) and at Boot Canyon if needed. These primitive campsites can accommodate about one hundred people during a fire event. Supplies would be brought in by mule packs or dropped by helicopter if wilderness restrictions are waived due to threats to life or property.

Mitigation of Undesirable Effects of Fire

Resource managers would continue reasonable efforts to avoid, minimize, and mitigate negative effects of the fire program. These include using best management practices under all alternatives to reduce any adverse impacts to human, cultural, and natural resources. Further, staff developed prescriptions, desired fuel loads, and designation of FMUs, were developed to minimize and mitigate negative effects under the fire program. Despite these efforts there may be need for short-term or long-term rehabilitation following fire. Staff will consult with specialists (archeologists, hydrologists, plant ecologists, wildlife biologists) to determine the treatments needed and then write, implement and monitor these plans. Common rehabilitation for environmental resources actions include: flush cutting stumps, replanting trees, removing trash, brushing in firelines, installing erosion control devices, felling hazardous trees, and carry out monitoring for short and long-term effects on vegetation and affected species. Damages to cultural resources from fire are usually permanent and cannot be rehabilitated; timbers burn, glass and metals melt, smoke blackens, and use of water or fire retardant may cause rock to crack. Below are measures specific to impact topics.

Impact topic (1) Life and Property and Impact topic (8) Resources for the Fire Program

- Reduce fuels with thinning, buffers and firebreaks particularly around developments.
- Use suppression (MIST) around buildings.
- Have evacuation plans ready for the Chisos.
- Avoid prescribed burning during high visitation periods.
- Minimize public exposure to burning events by closing roads and trails.
- Have personnel trained for needed tasks.
- Have sufficient personnel available or rapid access to a local or regional pool of trained and available staff.
- Coordinate with local agencies and managers to reduce cumulative impacts on region.

Impact topic (2) Visitor Experience

- Educate and notify neighbors, merchants and residents of all planned and unplanned park activities that have the potential to affect them.
- Provide quality interpretive experiences of the new FMP.
- Ensure the interpretive centers, web site, radio and interdivisional communications are current to reduce disruption of visitors and their plans.

Impact topic (3) Local Economy

- Ensure merchants and surrounding communities are notified of all prescribed and natural ignitions that may cause road closures and delay visitors.
- Provide local merchants and seasonal firefighters with opportunities to supply goods and services during fire events.
- Hire local people whenever possible for jobs in the park.

Impact topic (4): Vegetation and Impact topic (5): Threatened and Endangered Species

- Conduct prescribed burns outside breeding seasons.
- Create patchy burns leaving mosaics of vegetation that are refuges for animals and sources of reseeded.
- Keep up-to-date survey records of special status species.

- Locate potential firebreaks, staging camps and spike camps ahead of fire.
- Avoid using aircraft where it might disrupt nesting.
- Add rare species to GIS databases and continuing to build knowledge of life histories.
- Use refueling stations that protect against gasoline spills.
- Carry out rehabilitation immediately after fire if needed.
- Restrict prescribed fire to low and moderate intensity.
- Use Minimum Impact Suppression Techniques whenever possible.
- Measures specific to support Mexican long-nosed bat include burning when the park is wintering in Mexico, ensure 80 percent of agaves are maintained by patchy prescribed burns or suppression of wildland fire if needed, consult resource specialist.
- Follow Recovery Plan guidelines for federally listed species.
- Measures specific to support black-capped vireo include thinning and prescribed burns to protect key occupied territories, continue monitoring and do research on why suitable sites are not occupied, suppress any wildland fire that threatens territories, conduct any nearby burn outside the nesting and fledgling season.
- Measures specific to support Chisos Mountain hedgehog cactus include ongoing research into population dynamics, establishment and the removal of buffelgrass near affected individuals or populations.
- Measures specific to support Big Bend gambusia include ongoing monitoring, removal of giantreed at periodic intervals, prevention of gasoline entering the ponds, protection of cottonwoods against fire, restoration and replanting of the site if needed following fire.
- Manage wilderness in accordance with the Wilderness Act including: hand tools rather than mechanized tools and aircraft; no spike camps, crews or other personnel overnight; biodegradable retardant if it must be use; avoid spills, foam or erosion near water.

Impact topic (6): Cultural Resources

- Locate and identify sites vulnerable to fire effects prior to prescribed burns or mechanical thinning. Use an archeologist that meets the Secretary of the Interior’s standards.
- Follow protection measures for known cultural resource sites prior to prescribed burns, especially those vulnerable to fire and situated in or near the project area.
- Carry out post-fire surveys of natural ignitions whenever resources permit.
- Record new sites found during and after burns. Identify cultural resources park-wide to assist management of fire operations in future.
- Avoid ground disturbance during fire activities by identifying locations of potential natural firebreaks, spike campsites, and staging areas in previously surveyed areas. Do not construct fire control lines through cultural resource sites. Employ “Minimum Impact Suppression Tactics” whenever possible.
- Reduce fuels with thinning, buffers and fuel breaks.
- Locate vehicular routes away from cultural resource sites.
- Avoid using fire retardant near cultural resource sites.
- Work with tribes and work crews to protect ethnographic resources.
- Identify slash disposal areas away from all cultural resource sites.

Impact topic (7): Watershed Effects

- Initiate research burns to understand how to reduce fire safely in areas of heavy fuels.
- Allow low to moderate intensity natural ignitions where safe.
- Limit erosion following high-severity fire by creation of silt catchment devices at key points.
- Do research in lowland grasslands to better understand how to take advantage of natural conditions that foster grassland establishment.
- Support lowland desert grass reestablishment with water catchment, seeding and other measures whenever possible.

Table II-2: Schedule of prescribed burns under the three alternatives

Vegetation types: R=floodplain/riparian; DS = desert scrub; HDG = high desert grasslands; SW= shrub woodlands; GW= grassy woodlands; F= forest

Year/ month	Project name	Acres	Condition Class	Vegetation type	Purpose of treatment and monitoring objectives
2005	1314 Junction	531	II	HDG	Reduce hazard fuels and improve egress from Basin exit. <i>Monitor</i> shrub density, grass cover, species diversity, vegetation structure, recovery rates, agave mortality
2005	Boquillas Cyn Trailhead	10	III	R	Ecological restoration, fuel reduction, reduce saltcedar, exotics <i>Monitor</i> shrub density, grass cover, species diversity, vegetation structure, recovery rates, and non-native cover; cultural resources
2005	Panther Junction Blocks BC	29	II	HDG	Reduce hazard fuels <i>Monitor</i> shrub density, grass cover, species diversity, vegetation structure, recovery rates, and non-native cover
2006	Panther Junction Blocks EF-2 nd entry	55	II	HDG	Reduce hazard fuels, defensible space <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, rate of recovery, nonnative cover
2006	Tobosa Grass Research Burn	10	II	DS	Research determine fire's role in restoring/ maintaining grasslands <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, recovery rates. Erosion rates. Percent grass recovering by seed & rhizome, soils erosion. Cultural resources
2006	Chisos Basin Blocks BCP	22	II	GW	Reduce hazard fuels, defensible space <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, nonnative cover, agave mortality
2006	SE Rim	370	II	GW/F	Reduce hazard fuels, retain species diversity, vegetation structure, reduce fuels, shrubs, uneven age stands <i>Monitor</i> dead and downed, tree density by size class, foliar and basal cover of herbaceous and woody species and surface cover
2006	Santa Elena Canyon Overlook	180	III	R	Ecological restoration, fuel reduction, reduce saltcedar, exotics <i>Monitor</i> shrub density, grass cover, species diversity, vegetation structure, recovery rates, and non-native cover; cultural resources
2006	Sublett Farm Floodplain- 1 st entry	415	III	R	Ecological restoration, cultural restoration <i>Monitor</i> shrub density, grass cover, species diversity, vegetation structure, recovery rates, and non-native cover; cultural resources
2006	SW Rim Line Prep	26	I	GW/F	Reduce hazard fuels, maintain species diversity <i>Monitor</i> dead and downed fuels, tree density by size class, foliar and basal cover of herbaceous and woody species and surface cover. Monitor sensitive species
2007	Basin Campground Blocks FHKLMNO	67	II	SW	Reduce hazard fuels & create safety zone <i>Monitor</i> shrub density, grass cover, species diversity, vegetation structure, recovery rates, agave mortality and non-native cover
2007	Basin Block DEG	70	I	SW/GW	Reduce hazard fuels & create safety zone <i>Monitor</i> shrub density, grass cover, species diversity, recovery rates, agave mortality and non-native cover

Year/ month	Project name	Acres	Condition Class	Vegetation type	Purpose of treatment and monitoring objectives
2007	Alberico – Moir Long-term monitoring plots.	2.5	II/III	HDG/SW/GW/ F	Reduce hazard fuels, assess first entry burns; a 2 nd entry burn <i>Monitor</i> dead and downed fuels, tree density by size class, shrub density, foliar and basal cover of herbaceous and woody species, and surface cover
2007	RGV Campground	10	III	R	Reduce hazard fuels, removal of exotics, defensible space <i>Monitor</i> shrub density, grass cover, species diversity, vegetation structure, recovery rates, and non-native cover
2007	Gambusia pond	6	III	R	Wetland restoration <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, recovery rates, non-native cover
2007	Tamarisk thickets	3 x 20	III	R	Ecological restoration, removal of exotics <i>Monitor</i> tree density by size class, shrub density, foliar and basal cover of herbaceous and woody species, surface cover
2007	SW Rim Rx Burn	170	II	GW/F	Reduce hazard fuels, retain species diversity, vegetation structure, reduce fuels, shrubs, uneven age stands <i>Monitor</i> dead and downed, tree density by size class, foliar and basal cover of herbaceous and woody species and surface cover
2007	Green Gulch Mech Reduction A	8	II	HDG/SW	Reduce hazard fuels <i>Monitor</i> tree density by size class, shrub density, foliar and basal cover of herbaceous and woody species, surface cover. Cultural resources
2008	Johnson grass- Harte ranch	2	III	DS	Research fire & exotic species control <i>Monitor</i> % kill/recovery of exotic following fire + herbicide treatment, Shrub density, grass & shrub basal and foliar cover, species diversity. Cultural resources
2008	Buffelgrass – Johnson Ranch Road	2	III	DS	Research fire & exotic species control <i>Monitor</i> % kill/recovery following fire + herbicide treatment; shrub density, grass & shrub basal and foliar cover, species diversity, non-native cover. Cultural resources.
2008	Homer Wilson Ranch site	2	II/III	DS/HDG	Reduce hazard fuels <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, recovery rates, non-native cover
2008	Hannold Draw 2 nd entry	484	II	DS	Reduce hazard fuels <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, recovery rates, non-native cover. Cultural resources
2008	Basin Blocks AIJ	13.5	II	SW	Reduce hazard fuels, improve defensible space <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, rate of recovery, nonnative cover
2008	PJ Blocks GHI	9	II	HDG	Reduce hazard fuels <i>Monitor</i> shrub density, grass cover, species diversity, vegetation structure, recovery rates, and non-native cover
2008	G. fescue micro burns	0.1	II	SW/GW/F	Fuels reduction; Research Guadalupe Fescue establishment <i>Monitor</i> fire effects on species, species diversity, Guadalupe fescue vegetative and reproductive response. Tree density by size class, shrub density, foliar and basal cover of herbaceous and woody species, surface cover
2008	Panther Junction Block D	52	II	HDG	Reduce hazard fuels <i>Monitor</i> Shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover

Year/ month	Project name	Acres	Condition Class	Vegetation type	Purpose of treatment and monitoring objectives
2008	North Boundary or North Windmill (Chalk Draw)	200	II	DS	Reduce hazard fuels <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover. Cultural resources
2008	Green Gulch corridor Mech Reduction B	8	II	HDG/SW	Reduce hazard fuels <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, nonnative cover, agave mortality. Cultural resources
2009	Basin (Sewer Lagoon to Panther Pass)	240	II	SW	Reduce hazard fuels in high use corridor. <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, rate of recovery, no-native cover, agave mortality, Cultural resources
2009	Johnson grass-Harte Ranch	2	III	DS	Research grasslands response to fire <i>Monitor</i> % kill/recovery of exotic following fire + herbicide treatment, Shrub density, grass & shrub basal and foliar cover, species diversity
2009	Buffelgrass-Johnson Ranch Road	2	III	DS	Research grasslands response to fire <i>Monitor</i> Percent kill/recovery of exotic following fire + herbicide treatment, Shrub density, grass & shrub basal and foliar cover, species diversity
2009	Homer Wilson Shearing Pen	1	III?	DS	Reduce hazard fuels <i>Monitor</i> Shrub density, grass & shrub basal and foliar cover, species diversity, recovery rates, non-native cover
2009	Lone Mountain 2 nd entry	640	II	DS/HDG	Reduce hazard fuels <i>Monitor</i> Shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover
2009	Dick-Peddie Plot 4/ Boot Canyon	0.1 acres	II	F	Research burn <i>Monitor</i> tree density by size class, shrub density, foliar and basal cover of herbaceous and woody species and surface cover. Cultural resources
2010	Basin Block BP	13	II	GW	Reduce hazard fuels <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, nonnative cover, agave mortality
2010	Panther Junction Block A	56	II	HDG	Reduce hazard fuels <i>Monitor</i> Shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native expansion/invasion.
2010	Green Gulch West	200	II	HDG/SW	Reduce hazard fuels <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover, agave mortality
2010	RGV/Boquillas Overlook	10	III	R	Reduce hazard fuels/control exotic species <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover
2010	Green Gulch corridor Mech Reduction C	8	II	HDG/SW	Reduce hazard fuels <i>Monitor</i> Shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover, agave mortality. Cultural resources
2010	RGV-Gambusia Wetland 2 nd entry	10	I	R	Reduce hazard fuels <i>Monitor</i> photo points to observe changes in vegetation structure
2011	Green Gulch corridor Mech Reduction D	8	II	HDG/SW	Reduce hazard fuels <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover, agave mortality. Cultural resources

Year/ month	Project name	Acres	Condition Class	Vegetation type	Purpose of treatment and monitoring objectives
2011	Toll Mountain	?	II	F/GW	Research burn – intensity effects <i>Monitor</i> tree density by size class, shrub density, foliar and basal cover of herbaceous and woody species and surface cover. Cultural resources
2011	Maple Canyon Basin	?	II	GW/SW	Reduce hazard fuels <i>Monitor</i> tree density by size class, shrub density, foliar and basal cover of herbaceous and woody species and surface cover, agave mortality. Cultural resources
2011	Gambusia pond- 2 nd entry	6	I	R	Wetland restoration <i>Monitor</i> recovery of natives including seedling establishment, pond flows and water table levels when possible. Cultural resources
2012	SE Canyon Overlook- 2 nd entry	174	III	R	Ecological restoration, control exotic species <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover
2012	Sublett Farm Floodplains- 2 nd entry	415	III	R	Ecological restoration, cultural resource site, control exotics <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover
2012	RGV Campground East	18	III	R	Reduce hazard fuels <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover
2013	Casa Grande-2 nd entry	230	I	GW/SW	Reduce hazard fuels <i>Monitor</i> tree density by size class, shrub density, foliar and basal cover of herbaceous and woody species, surface cover, agave mortality
2013	Basin Campground	70	II	GW/SW	Reduce hazard fuels <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover, agave mortality
2013	Basin Block DEG	70	II	GW/SW	Reduce hazard fuels <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover, age mortality
2013	Panther Junction Blocks BC-2 nd entry	9	II	HDG	Reduce hazard fuels <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover
2013	SE Rim-2 nd entry	370	II	GW/F	Reduce hazard fuels, maintain species diversity <i>Monitor</i> tree density by size class, shrub density, foliar and basal cover of herbaceous and woody species and surface cover
2014	RGV Campground – 2 nd entry	10	III	R	Reduce hazard fuels, control exotics, create defensible space <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover
2014	Basin Blocks BCP	22	II	GW	Reduce hazard fuels, maintain defensible space <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover, age mortality
2014	Panther Junction Blocks EF- 3 rd entry	55	II	HDG	Reduce hazard fuels, maintain defensible space <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover

Year/ month	Project name	Acres	Condition Class	Vegetation type	Purpose of treatment and monitoring objectives
2014	1314 Junction 2 ND Entry Burn	531	II	HDG	Reduce hazard fuels <i>Monitor</i> shrub density, grass & shrub basal and foliar cover, species diversity, vegetation structure, recovery rates, non-native cover, age mortality
TOTAL ACRES		5984.2			

While prescribed burns are often planned a year ahead, the availability of funding, weather, equipment and staff, determine when the burn can be conducted safely.

Range of Alternatives

Four fire management alternatives were considered by the IDT for their potentially different outcomes. The major differences were management strategies within the fire management units (FMUs), prescriptions governing wildland fire and prescribed fire use, control of fire along the park border, and the planning horizon for reducing hazard fuels.

Alternatives Retained for Analysis

Comparisons of the three alternatives retained for analysis are contained in Tables II-8, II-9 and II-10

No Action Alternative- Alternative A:

Organization

The existing (1994) plan uses two fire management units (FMUs) that are defined by specific fire management strategies. FMU 1 covers the Chisos Mountains, developments, a one-mile buffer inside the park border, and a section bounded by highway 385 from Persimmon Gap to Panther Junction west and north along highway 118 and dipping down to approximately Santa Elena overlook in the southwest. Prevailing summer winds and likely fire originate in the southwest suggesting this delineation was to preserve northern and western viewsheds rather than protect the southern and eastern flanks of the Chisos. The southern boundary is the mid-channel of 118 miles of the Rio Grande River, also the international border with Mexico. The river channel was treated as a wildland fire use area because the river formed a substantial barrier to fire and floodplain vegetation was sparse. Legally all wildland and prescribed fire is suppressed within a one-mile buffer along the park boundary to contain fire within federal lands. Administrative, legal, political and man-made features have prominently shaped the boundaries of this FMU, which contains developments, historic districts and other cultural resources, legally protected plant and animal species, and some wilderness. The arrangement of FMUs under Alternative A is illustrated in Figure II-3 below.

Tools for fire management in FMU 1 include suppression, prescribed fire and non-fire fuel treatments. Suppression protects developments at Panther Junction and Rio Grande Village, Historic Districts such as Burro Mesa, archeological sites, and federally protected species. Prescribed fire has been used to lower fuels primarily around buildings. Non-fire treatments include mowing along roadsides and use of chainsaws to remove saltcedar from upland springs.

The second FMU 2 with three fire subunits covers the eastern and southwestern drier and less flammable portions of the park. Most of this unit is proposed wilderness but includes Rio Grande Village and Castolon campgrounds, Mariscal Mines, Dugout Wells and Sam Nail Ranch historical sites, and other cultural and natural resources. Lighting ignitions are allowed if they meet predetermined management objectives but sparse and discontinuous fuels over much terrain carries fire for short distances before it lays down. Expansion of exotics particularly along the river corridor and up the arroyos (Guertin and Halvorson 2004) may change fire behavior in future. The full-spectrum of fire tools may be used in this FMU to meet resource objectives, protect infrastructure, cultural resources and listed species.

Outcomes

Authors of the existing plan established many of the same goals as the current IDT, and proposed a phased introduction of wildland fire, moving from the current suppression regime to natural fire across most of the park (p.5-6 old FMP). The FMP quotes staff and resource shortages, lack of training, access to basic decision-making data, protection of life and property, protection of cultural resources and interagency planning as all obstacles to full implementation of the fire program (p.7-8 old FMP). Park history also demonstrates that opportunities to introduce wildland fire were hampered by an inflexible decision-making tree for natural ignitions, that has continued the mostly suppression policy for 10 more

years. This decision matrix is illustrated in Figure II-4. A total of 1539 acres were treated with prescribed fire since 1994 while 19,021 acres from 239 lightning strikes burned under natural ignitions. Table II-4 lists all prescribed burns since 1980.

Fuels continue to build in the Chisos moving from fuel model 8 to 10 in forest under the national fire policy rating system. There are few planned prescribed burns to lower fuels and limit the spread of wildfire into the Chisos, and no plans to develop firebreaks in this wilderness. Staff are intrigued that although fuel loads are high and desert grasslands would carry fire from the slopes into the upper mountain reaches, ignitions observed during the monsoons have not led to active fires. Perhaps the rugged topography has stopped infant strikes at talus slopes or rocky outcrop, or perhaps relative humidities and fuel moistures have been too high to support fire. Whatever the reason(s), fires have occurred in the Chisos in the past, and higher fuel levels mean future fires are likely to be of higher intensities (energy released by fire) and severities (degree of burn to soil organic matter and canopy) than in the recorded past. Under wilderness designations minimum impact techniques must be applied in controlling fire in wilderness. These dictate use of non-mechanized equipment such as hand held tools rather than chainsaws and airborne retardants. These techniques limit ground disturbance and noise, but can be overridden by an incident commander or superintendent when life or property is deemed in danger.

The decision-making matrix used under the current FMP is illustrated in Figure II-4. All questions must be answered with a “yes” to allow a fire to burn.

Prescriptions for Wildland fire Use and Prescribed fire

Predetermined conditions for prescribed fires and wildland fires guide incident commanders in their preparation and response to fire events. Under the current FMP, prescribed fires have been contained around developments, but two have escaped while reducing fuels in natural areas. The difficulty of containing fire has led the fire program to reevaluate fire prescriptions, and training and monitoring needs to consider how to safely make the transition between high fuel loads and use of prescribed fire, to allowing more natural ignitions safely in the park.

Prescribed fire prescriptions for FMU 1 guides hazard fuel reduction, and debris disposal to meet air quality control guidelines. In FMU 2 prescriptions guide wildland fire use. The main criteria are:

- Regional and national preparedness level is II or less (preparedness level reflects local conditions for fire spread and regional and national availability of people and equipment for managing events—the higher the level, the more extreme the conditions and taxed the resources); may be restrictive (especially regionally) during the spring months when Planning Level 3 may apply.
- There must be 3 or fewer fires burning in the park at any one time.
- The fire must be caused by lightning and be in FMU 2.
- Any fire deemed to endanger life or property inside or outside the park will be suppressed.
- The burning index for fuel model T must be below 85th percentile for 4 consecutive days (burning index is an estimate of the relative potential difficulty of fire control based on how fast and hot a fire could burn; fuel model T predicts fire behavior for a mixture of woody shrubs and grasses).
- Fire spotting must be less than ¼ mile or suppression is required.
- Fire behavior over current and predicted 24 hours will not threaten FMU 2 border.
- Smoke does not exceed air quality standards.
- Other criteria fire based on fuel moisture, relative humidity and wind speed conditions are appendix F in the 1994 FMP.

Table II-3: Summary of prescriptions under 1994 FMP

Ranges	Level 1	Level 2	Level 3
Wind speed	8-16	5-10	4-6
Relative humidity	30-70	20-70	10-70
% Fuel moisture	8-16	6-8	4-6
Fuel models	1, 2, 3, 4, 6, 8, 9	1, 2, 3, 4, 6, 8, 9	1, 2, 3, 4, 6, 8, 9

Under the current prescriptions wind speed is perceived as the major factor determining fire effects. With higher winds, fuel moisture and relative humidity must be higher to ensure adequate control over fires. With declining wind speed, fuel moisture and relative humidity can be lower (drier) to achieve the same level of control. Some forest areas in the Chisos have been assessed as fuel model 10 and lie outside the above prescriptions.

Mitigative Measures

These are outlined under “Elements Common to All Alternatives.” Alternative A does not reduce high levels of accumulated fuels particularly in forest, apply fire prescriptions that allow the introduction of fire in a manner that is consistent with naturally occurring ecological processes (assuming more frequent fire at low to moderate fire intensities), or restore fire-adapted plant communities that have been altered by human activities such as mining, grazing, cultivation and fire suppression. Implementation of this alternative under the 1994 FMP has not meet the goals outlined at that time and constitutes an increasing risk to park resources and values.

Alternative A -- No Action

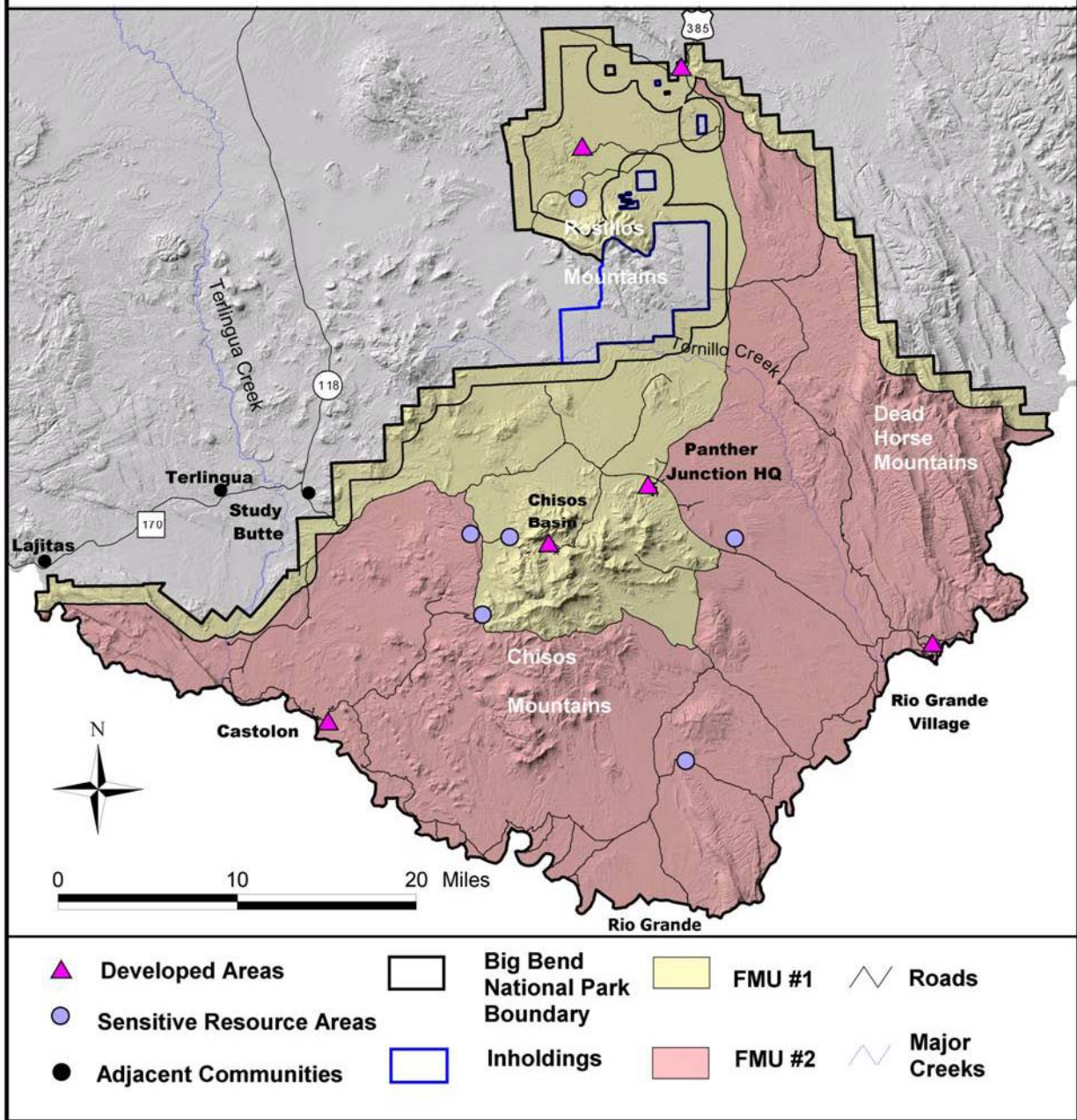


Figure II-3: Alternative A: No Action Alternative

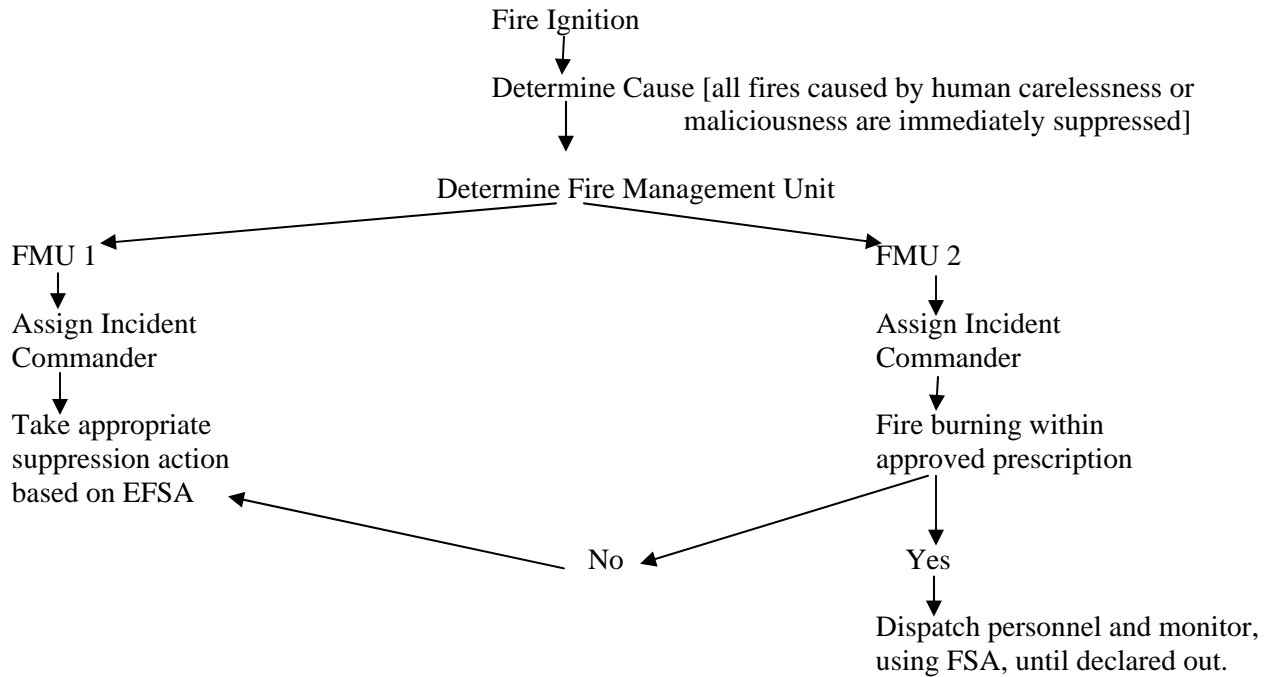
Table II-4: Prescribed burn program 1980-2003.

Name of Burn	Date of Burn	Acres	Vegetation
Tamarisk Piles	Jul-2003	2	exotic
RGV Wetland	Feb-2003	10	riparian
Comanche Draw	Feb-2003	537	desert shrub
Tules	Jun-1999	0.1	riparian
Basin CG	May-1999	9	pinyon-juniper
Lone Mtn.	Apr-1999	645	sotol grassland
PJ Block B	Mar-1999	23	sotol grassland
Bone Spring	Oct-1998	0.2	riparian
PJ Block D	Apr-1998	23	sotol grassland
PJ Block A	Apr-1998	40	sotol grassland
CB Block DEG	Sep-1997	70	pinyon-juniper
PJ Block EF	Jul-1997	52	sotol grassland
Helispot	May-1997	4	sotol grassland
CB Block B	Jan-1996	10	pinyon-juniper
PJ Blk A-90	Jul-1990	5	sotol grassland
San Vicente	May-1988	40	riparian
Basin RX2	Feb-1988	8	pinyon-juniper
Basin RX1	Feb-1988	10	pinyon-juniper
Thistle RX	May-1987	5.5	exotic
Basin RX4	Feb-1987	3	pinyon-juniper
Basin RX3	Jan-1987	2.6	pinyon-juniper
Basin RX2	Jan-1987	5.4	pinyon-juniper
Basin RX1	Jan-1987	5.5	pinyon-juniper
Block B	Apr-1986	1.2	pinyon-juniper
Block A	Apr-1986	0.5	pinyon-juniper
Block C	May-1985	0.1	
Block B	Apr-1985	0.1	
Block A	Apr-1985	0.1	
Basin Burn	Apr-1983	30	pinyon-juniper
Tornillo	Jun-1980	5	Exotic
Plot 4 Boot Canyon	Jun-1980	0.1	Forest
Total Acres		1539.1 ac	

Table II-5: Lightning Ignitions 1980-2004

Year	No. fires	Acres burned	Year	No. fires	Acres burned	Year	No. fires	Acres burned
1980	5	3.3	1990	16	214.5	1999	11	29.8
1981	2	680.1	1991	6	1492.1	2000	9	7
1982	4	17	1992	8	2687.1	2001	11	10.5
1983	5	0.9	1993	9	3501.8	2002	19	2.2
1984	3	8.1	1994	13	3876.9	2003	3	0.3
1985	6	439.7	1995	17	86.4	2004	4	0.4
1986	1	6.7	1996	11	15.8			
1987	6	111.5	1997	18	2.7			
1988	9	606.1	1998	6	0.6			
1989	37	5219.5						
							239	19,021 acres

Current Decision Flow Chart for Initial Action on Ignitions (FMP 1994)



ESFA: (Escaped fire situation analysis) An analysis of alternative suppression strategies for either confining, containing, or controlling a wildfire.

FSA: (Fire situation analysis) An analysis of alternative strategies for managing a prescribed natural fire for the desired objectives and within prescriptions.

Figure II-4: Decision Tree for Initial Action on Ignitions. Alternative A

Alternative B: Full Wildland Fire Use

Purpose

This alternative was developed as an option to quickly reintroduce fire into the park. Both prescribed fire and wildland fire will be used to (1) reduce fuel loadings in all vegetation types that are at risk of high-intensity and high-severity fire, and (2) move ecosystems towards dynamic states by controlling shrubs, maintaining grasslands, reducing fuels or renewing plant communities. Allowing more fire stems from confidence that low and moderate-intensity prescribed burns and natural ignitions (wildland fires) are needed, and that, possible long-term negative effects can be tolerated even though desired vegetation conditions are not well documented. Effects following fires would be monitored to build knowledge particularly of fire in the Chisos. Vegetation and fuels would be assessed in the Chisos to identify areas where natural fire can burn safely either after prescribed burns or without prescribed burns. In the event of natural wildland fires where visitor safety was not an issue, fire would be allowed to burn at low and moderate intensities, initiating the return of historical fire regimes. The main differences between this Alternative and Alternative C is this alternative has no requirement for post-fire monitoring of prescribed burns, nor requires that research results on fire effects and fire dynamics guide the introduction of fire in the Chisos. Reduction of fuels is expected to be much quicker over a wider area than under Alternative A.

Organization

Alternative B has two FMUs, as shown in Figure II-5. FMU 1 includes developments, fire-sensitive cultural resource sites, legally protected species and 1-mile buffer along park boundaries where fire must

be suppressed. Agreements are being negotiated with neighboring agencies and large landowners to shrink the buffer to a variable limit that allows fire to burn to natural or manageable boundaries such as the river, roads, bare areas, and cliffs both in the park and beyond. The expected benefits include more cost-effective use of fire management resources, safer fire management practices, and less damage to soils and vegetation from suppression activities. FMU 2 includes the rest of the park.

Expected Outcomes

This alternative offers fuel reduction more quickly than Alternative A or C and may be more effective at preventing widespread fire in the Chisos under extreme conditions. The IDT felt that since historical fire intensities and regimes are not well documented it is conceivable that stand-replacing fire could have occurred in the Chisos prior to European settlement. Fire intolerant species in mesic areas would develop between such fires. Despite the benefits from rapid fuel reduction, the IDT questioned risk to public values, unknown fire effects in particular species and habitats, fire dynamics in high fuel situations, the difficulty of managing fire in rugged terrain under low and moderate fire intensities (required under prescriptions), and the possibility that exotic plant species, now widespread in the park, may colonize bare areas following fire. They concluded that this was a hard-to-safely-implement alternative.

Prescriptions

The decision criteria for allowing fire under Alternative B are more flexible than Alternative A and are illustrated in II-6. Variables for estimating fire effects have changed since 1994 and a direct comparison with measures used at that time is not possible. However, the current variables when combined create a more comprehensive measuring stick than was used previously. The more liberal prescriptions proposed are derived from staff experience with fire over the past 10 years within the park and from fire use in comparable areas. Major changes include:

- Not assigning a prohibitory wind speed in areas where fuels are low and widespread fire is highly unlikely;
- Assigning an upper limit of FDFM (Fine Dead Fuel Moisture) to ensure that research fires in the Chisos will burn under low to moderate intensities;
- Assigning a lower limit to LFM (Live Fuel Moisture) that will protect mature trees especially in the Chisos;
- Increasing the upper limit of the LFM to ensure management ignited fires burn and the benefits outweigh the costs; and,
- MFWS (Mid-Flame Wind Speed) is set to ensure spread is slow or limited where preservation of resources is desired.

Should natural fires occur outside prescriptions they will be monitored closely and either suppressed, or allowed to extinguish naturally where natural barriers to fire exist. Overall these prescriptions together with more liberal initial decision-making criteria provide more flexible tools for allowing burns for management purposes. Suppression actions for Alternative B are the same as for all alternatives. Non-fire treatments are the same as Alternative A.

Mitigative Measures

Mitigative measures for cultural and natural resources are outlined in “Elements Common to All Alternatives.” Proposing more fire in the park will require explanation to the visiting public. Three to four generations of Texans heard Smokey Bear say “no fires” in the forests, and on the range as well. Widespread, high-intensity fires throughout the West in recent years reinforces the notion that fires create “bads” when they burn and no “goods.” The more complex story of fire in ecosystems will require frequent and convincing messages by park staff and scientists. Understanding the complexity of fire effects make interpretative activities a high priority for park staff. Helping the public understand the process of fire planning has begun with a series of explanatory posters currently at Sul Ross University.

They will be moved to sites within the park when space is available. Interpretative staff intend including an educational column on the park web site and in local papers, and to develop displays and written materials to assist interpretative efforts.

Alternative B -- Full Wildland Fire Use

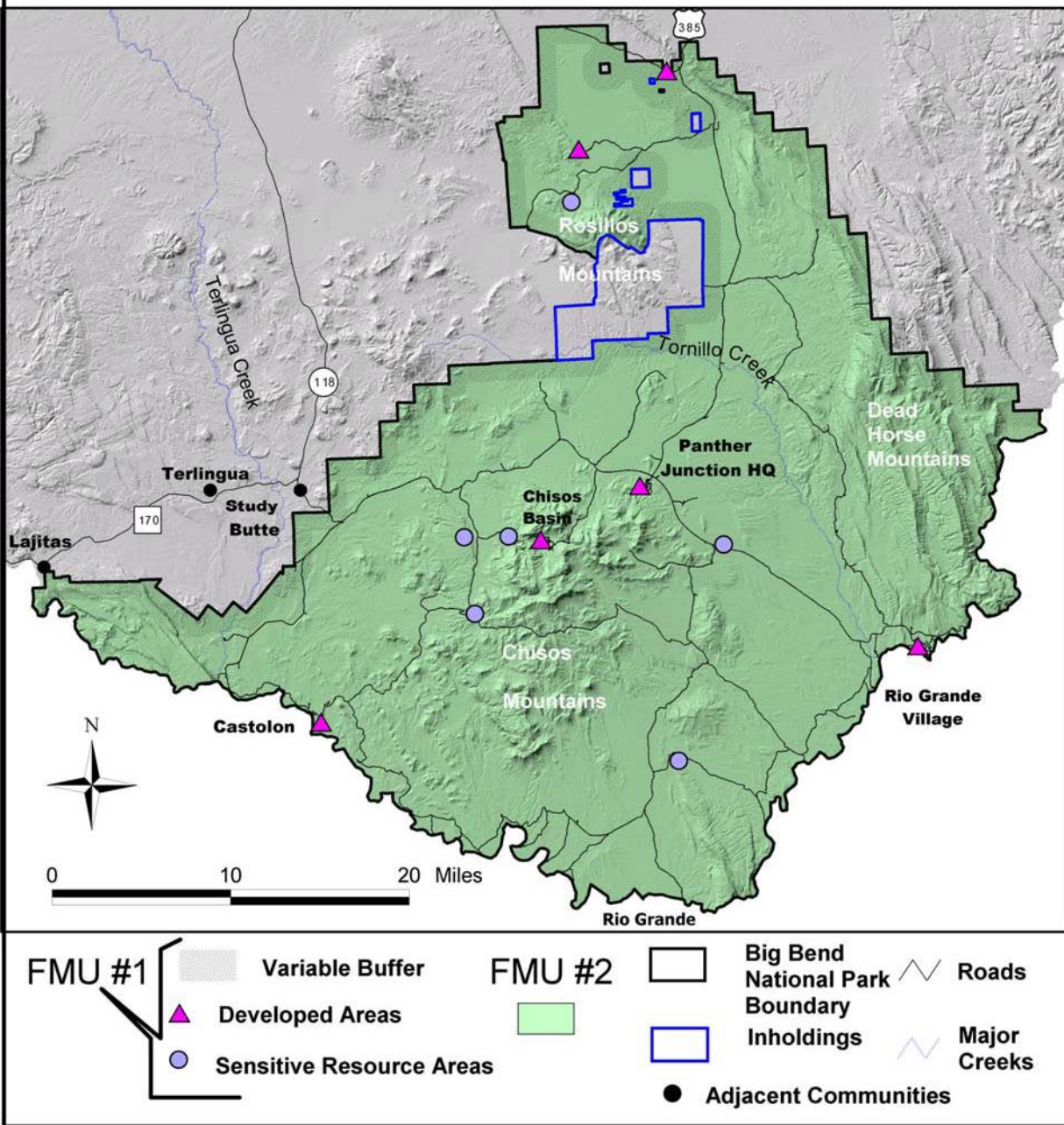
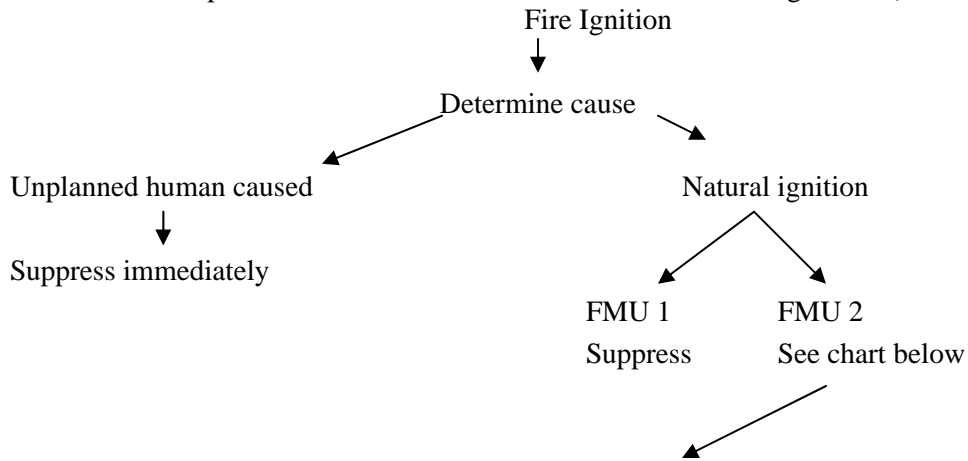


Figure II-5: Alternative B: Full Wildland Fire Use

I. Proposed Decision Flow Chart for Initial Action on Ignitions (New FMP)



- Must answer YES to all criteria to reach a GO decision.
- Any NO answers result in a NO-GO decision and declaration of a wildfire. Once declared, the fire cannot be reverted to wildland fire use.

Figure II-6: Decision Tree for Initial Action on Ignitions for Alternative B & C

Decision Criteria (FMU 2)	Questions
Ignition	Is it a natural source? Is the location within a wildland fire use zone? <i>Or</i> , Can the natural ignition meet research requirements under Research Burns? [Fire use decisions depends on meeting location, values-at-risk, season, and desired outcomes criteria]
Management Objectives	Are resource objectives being met? Are potential effects on natural and cultural resources within the acceptable range of effects and variability?
Size	Is the current and expected size known? Is the potential risk for escape acceptable?
Fuels	Are live fuels moistures within prescription?
Weather	Are drought indicators acceptable (1000-hr TLFM*, Palmer drought index)
Topography	Is the terrain in locations for potential holding actions along the maximum management area accessible and safe for crews to work in?
Resource Availability	Are local, regional or national resources available?
Safety of Life and Property	Can the threats to firefighters, staff, visitors, residents, neighbors, associated property and infrastructure be minimized?
Environmental Constraints	Is smoke dispersal and direction acceptable?
Political Constraints	Is managing this fire for wildland fire use compliant with current policy, moratoriums, political constraints, funding and efficiency issues?
Summary	If YES to all above – manage within prescriptions

TLFM* = Time-lag fuel moisture. 1000-hour TLFM is a measure of moisture content of the largest diameter fuels.

Table II-6: Prescriptions for Prescribed and Wildland Fire Use For Alternative (B)

Parameters	Vegetation Types and Fuel Models					
	Flood Plain (3 & 8)	Scrub Desert (1)	High Desert Grasslands (2)	Shrub Woodland (6)	Grassy Woodlands (2)	Forest (10)
Fire Management Unit	1 & 2	2	2	2	2	2
Fine Dead Fuel Moisture (fuel particles <0.25" in size and measured in % of moisture)	Unlimited in non developed areas > 5% in developed areas	Unlimited in non developed areas > 5% in developed areas	> 5%	> 5%	> 5%	> 5%
MFWS (mph)	Unlimited in non developed areas < 8 mph in developed areas	Unlimited in non developed areas < 8 mph in developed areas	0 to 8	0 to 8	0 to 8	0 to 8
Live Fuel Moisture (%)	n/a	n/a	>100	n/a	>100%	>100%
Slope (%)	n/a	n/a	n/a	>25% ONLY in secure locations	>25% ONLY in secure locations	>25% ONLY in secure locations

Legend: (Attributes taken from Fire Behavior Field Reference Guide)

- Fine Dead Fuel Moisture (FDFM):** This relates to grasses and other fine texture or small particle fuels. The measurement considers temperature, relative humidity, time of day, aspect, slope, shading (from overstory or clouds), and season (winter, spring, summer, fall). Measurements range from 2 to 20%. The higher percentages indicate wetter fuel. From experience at Big Bend, FDFM reaching 5% has been a trigger for sustained fire spread in our patchy grassland fuels.
- Mid Flame Wind Speed (MFWS):** MFWS is the average velocity of wind measured at eye level. This can be read directly with a handheld anemometer or calculated from weather station wind speed measurements (at 20 ft and average over 5 minutes) with the consideration of the sheltering effect from vegetation or topography. From experience at Big Bend, fires will spread in the grasslands if mid flame wind speed is > 8 mph. If less than 8 mph, fires tend to not spread on flat ground.
- Live Fuel Moisture (LFM):** LFM is related to the stage of vegetative growth and moisture content of live vegetation. LFM may range from a high of 300% for fresh, moist foliage early in spring to 30% for completely cured foliage. The 100% live fuel moisture rating is considered mature foliage with new growth complete, comparable to older perennial foliage. From experience at Big Bend, 100% LFM has been sufficient moisture content to protect mature trees from fire related injury during moderate fire behavior conditions. During the Casa Grande Fire of 1999, LFM was recorded ranging from 65-85% and mature trees were killed under higher

intensity fire behavior conditions. Where LFM is not a crucial factor in predicting fire behavior in certain fuel models, it is listed as n/a.

- **Slope and Secure locations:** This relates to the steepness of the topography. A rating of “n/a” means to allow burning on all slopes in these vegetation types. At higher elevations and woody vegetation, prescribed and natural ignitions are allowed on slopes > 25% only if the fire spread is a backing fire (backing down hill, against the slope) or the fire spread will likely stop against fire spread barriers (talus slopes, cliffs, and other secure locations). From experience at Big Bend, slope steepness has not been a strong factor in fire behavior predictions.

Fuel Models (derived from Anderson, 1982)

- 1 = Fire spread is governed by fine, porous and continuous herbaceous fuels that are almost cured. Typical of grasslands and grass-shrub assemblages. High rates of spread are possible. This model predicts fire behavior in Scrub Desert vegetation, although it has very patchy fuels.
- 2 = Fire spread is from fine cured herbaceous fuels in addition to litter and downed stem wood. Open shrublands, scrub oak and some juniper-pine assemblages fit this model. May produce intense fires. This model fits High Desert Grasslands and Grassy Woodlands, although the dead fuel loadings are lighter than the model's average.
- 3 = Fire is carried through tall grasses where one-third or more are considered cured or dead. Highest intensity of the grass fires, especially under wind. Giantreed stands along the river fit this model.
- 6 = Fire carries through the shrub layer at moderate wind speeds (8mi/hr) but drops to the ground at lower speeds and at breaks in the canopy. Shrub woodlands found in lower mountain drainages.
- 8 = Slow-burning ground fires with low flame lengths. The fire supporting layer is composed of compact leaf litter, needles, leaves and twigs. Tamarisk and Mesquite thickets along the river.
- 10 = In addition to leaf litter there are up to 3 tons per acre of downed dead material. Fires can be intense burning at ground and canopy level and be difficult to control. This model is characteristic of the forest vegetation category.

Alternative C: Progressive Wildland Fire Use

Purpose

Concerns about possible outcomes from Alternative B's more liberal fire use led to the development of Progressive Wildland Fire Use or Alternative C. Consideration of Alternative B led to the following observations: (1) burning without identifying fire effects in sensitive habitats involves considerable risks to park resources and values; (2) adherence to a particular management trajectory without a supporting research program could result in significant negative impacts on the vegetation over the long-term; (3) research burns would assist staff understand how to safely reintroduce fire in particular habitats, provide local, species specific, as well as long-term and ecosystem wide information, which together with; (4) adaptive management processes - learning and reflecting on results on a regular basis -will help prevent negative unintended consequences. These observations led to the proposal of a research platform guiding Alternative C, and considering the Chisos a Special Treatment Zone under this FMP.

Organization

There are two FMUs under Alternative C and a Special Treatment Zone. The inclusions and treatments for FMU 1 are the same as Alternative B. FMU 2 covers the rest of the park allowing wildland fire to burn where park resources, unique habitats, threatened species and infrastructure are not at risk. Prescriptions and decision criteria are the same as for Alternative B.

The IDT designated the Chisos a Special Treatment Zone within FMU 2. Wildland fire will be permitted within prescriptions and monitored very closely. Prescribed burns will be used to answer research questions, protect developments and support the protection of federally listed species. Data will be collected identifying species-specific responses to fire, fire dynamics under differing fire intensities, and high fuel loads. Burns will be small, include multiple repeat treatments, be no more than 10% of any habitat, require pre and post-fire monitoring, include analysis and evaluation, and require incorporation into management discussions and decision-making. Information from research burns will guide the introduction of fire particularly into the forest and woodlands of the Chisos. Fire will be excluded from a Research Natural Area in upper Pine Canyon, above the campsites and the end of the road. This area has not experienced fire in many decades and will serve as a reference site in the event of future fire. Research fires will also be conducted in other areas of the park to meet resource objectives such as grasslands restoration, protecting or enhancing habitat of listed species, and developing control strategies for exotic species.

Research Approach

Fire researchers have refined prescriptions to manage for the severity of fire under normal weather conditions. What is less well known is the outcome of fires at varying intensities on particular species, and habitats. Staff are seeking ways to protect valued resources including the mature trees in the Chisos, relict species, endemics and unique habitats. National fire-return intervals are a guide to maintaining normal fuel levels and condition class I-II. These guidelines are averages and formulated to cover a range of environmental variables. Big Bend staff want fire intervals that reflect local conditions. They believe that continuing the efforts of fire researchers began in the late '70s and early '80s, who established plots in Boot Canyon, SE Rim, Laguna Meadow and on the slopes of Emory Peak will lead to knowledge about fire return intervals and how to introduce fire into the Chisos safely. Just one plot (of Arizona Cypress) was burned in Boot Canyon and only 1 year of data collected. Multiple years of data are needed to indicate mortality, guide the refinement of prescriptions and indicate trends, helping make more informed decisions about appropriate fire frequencies for the park's vegetation types. The research approach and initial reference base follow in text boxes.

Expected Outcomes

Increasingly natural resource managers are being asked to manage vegetation to objective and measurable outcomes. The park has limited research to support this knowledge-based approach, and is cautious about accounting for multiple interactions among environmental variables. Clear, objective, and measurable outcomes implies that managers understand how periodic perturbations such as fire, suppression, grazing, logging, and mining affect park plant communities, how the communities have changed over time, and how other larger perturbations caused by climate change, insect attacks, disease, and decreasing air quality are also impacting these vegetation communities. Such knowledge assumes managers know the history of the area, have access to reliable research, and can compare the park to nearby reference sites to understand a range of suggesting the plant communities' structure and composition. A research program can deepen knowledge to provide appropriate monitoring standards and assist staff ask better questions.

Monitoring associated with research burns also provides a tool to develop knowledge about the approximately 120-130 rare and endemic plant species in the park. So little is known about some of these species that they cannot be protected under the legislation for threatened and endangered species. Knowledge of fire effects on individuals, populations, and surrounding habitat is critically important to the management of these plants. Staff propose that pre-fire and post-fire monitoring of prescribed and

research burns take into account the lifecycle of these lesser known species to ensure their protection in the park.

Prescriptions

Prescriptions are outlined in Table II-7 and are similar to Alternative B. They are designed to provide protection for most mature trees. Staff recognize that cycles of burns are required to reduce shrubs encouraging the return of grasses and low-intensity faster surface fires. Staff also recognize the trade-offs of fire managers who must balance the need to create a return on an investment. Prescribed burns take months of preparation from developing burn plans, monitoring, and achieving compliance. They are costly to undertake requiring coordination of many staff and resources. Suppression actions and non-fire treatments for Alternative C are the same as other alternatives.

Fire Ecology Research at Big Bend

The fire ecology program at Big Bend National Park will tailor the fire effects monitoring program to provide pertinent information for adaptive fire management of vegetation at Big Bend National Park. Research burns, by definition, will have a research component, that will include replicated treatments (a minimum of 3 treatment replications) that serve as either “controls” (untreated plots) and plots that receive the experimental treatment of prescribed fire, wildland fire use or mechanical thinning, herbicide application or some combination of treatments (i.e. burning + herbicide). Monitoring will also be conducted on fuels projects that are not designated as research to provide feedback as to whether or not natural, cultural or fire management objectives are being met and provide additional information to adaptively manage both wildland fire use and prescribed fire. First entry fuels treatment(s) into a monitoring type, will be considered research treatment having replicated treatment plots and replicated control plots.

A reasonable attempt will be made to address each of the following Fire ecology research questions in each prescribed fire opportunity (1) effects of fire on plant community composition, (2) effects of fire on rare or sensitive plant and animal species, (3) soil movement, (NOTE: changes in plant composition can be used as a surrogate for soil sterilization (denuded surface) and soil movement =erosion) in response to fire, (4) effects of fire on fuel loading, ladder fuels, and fuel size class distribution, and (5) forest stand age and size class structure. A Fire Effects Monitoring Plan for the Chihuahuan Desert National Park Units (AMIS, BIBE, CAVE, GUMO) will be drafted that will detail monitoring objectives and methods used for research and monitoring to provide scientifically credible data.

Legacy data collected in the past fifty years (e.g. Warnock 1970a,b; Whitson 1965, 1989; Dick-Peddie and Alberico 1977; Meents and Moir 1981, 1982; Wondzell and Ludwig 1983; Dunham 1996; Muldavin et al. 2001) will be used to evaluate ecological trajectories and responses to fire. Whenever possible, existing plots from these studies will be remeasured and the resulting data added to the fire ecology database for the park. Many of these data sets need to be organized, collated, and entered into modern electronic databases to be useful. In addition, many legacy plots will need to be re-located based upon location descriptions in the initial reports. We will accomplish these tasks in advance of the implementation of Research Burns.

These research and monitoring goals will need to be funded by creative combination of resources, including NPS Resource Management funding, FIREPRO, CESU, and other government and NGO sources. Securing funding for adaptive management research is critical to the implementation of the Fire Management Plan.

Initial Research Sources:

Dick-Peddie, W.A. and M.S. Alberico. 1977. Fire ecology study of the Chisos Mountains, phase I. CDRI contribution No. 35. BIBE files.

Dunham, A.E. 1996. Long-term ecological monitoring of the U.S.-Mexico borderlands in the Big Bend national Park, TX. BIBE files.

Meents, J.K and Moir, W.H. 1981. Fire Ecology study of the Chisos Mountains, phase II. CDRI contribution No. 17. BIBE files.

Meents, J.K and Moir, W.H. 1982. Fire ecology of desert grasslands in Big Bend National Park. CDRI contribution No. 120. BIBE files.

Muldavin, E., Wondzell, S., and J.A. Ludwig. 2001. Forty years of vegetation change in desert grasslands of Big Bend National Park. BIBE files.

Wondzell, S.M. and J.A. Ludwig. 1983. Plant succession as influenced by soil-geomorphic processes of semi-arid piedmonts of the U.S.-Mexico border. Final Report. BIBE files.

Warnock, B.H. 1970a. Charts, measurement data and examination on selected A& M circular plots. BIBE files.

Warnock, B.H. 1970b. Summary of belt transect data at Big Bend National Park. BIBE files.

Whitson, Paul D. 1965. Phytocoenology of Boot Canyon Woodland, Chisos Mountains, Big Bend National Park, Texas: Permanent Plot Supplement BIBE files.

Whitson, Paul D. 1989. Documentation and analysis of Boot Canyon permanent plots initiated in 1964. BIBE files.

Mitigation Measures

Management responses are similar to Alternative B and include physical rehabilitation of sites, ongoing interpretive efforts with public and neighbors, continuing to build knowledge by mapping endemics, threatened and rare species, identifying containment strategies prior to fire, pre and post monitoring, identifying research questions and design in advance to take advantage of natural fire or for planning for prescribed fire; and pre-fire and post-fire monitoring undertaken at times appropriate for the species or plant communities; and continuing to analyze and incorporate research data into management decisions.

Alternative C -- Progressive Wildland Fire Use

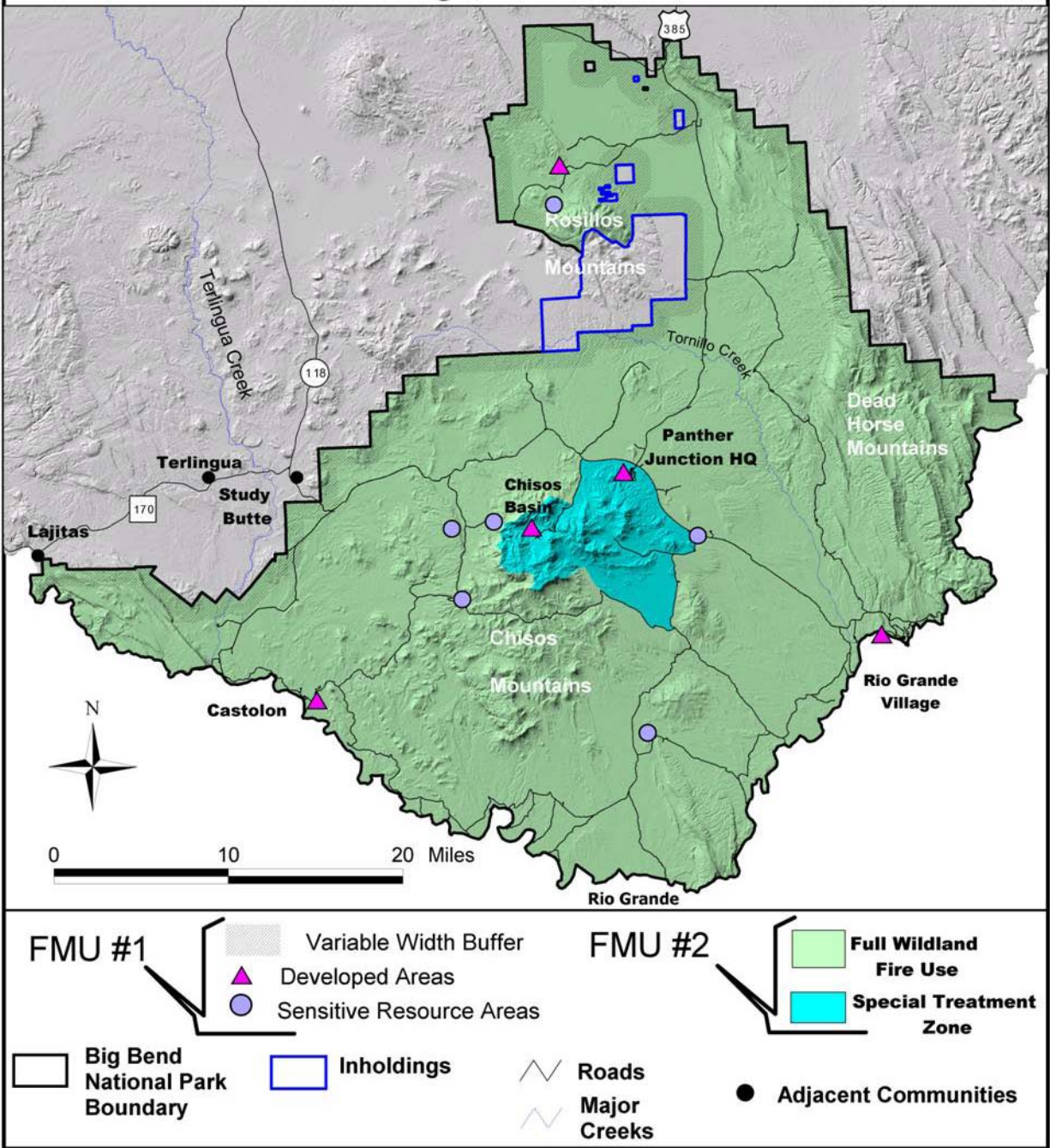


Figure II-7: Alternative C: Progressive Wildland Fire Use

Table II-7: Prescriptions for Alternative C

Parameters	Vegetation Types and Fuel Models					
	Flood Plain (3 & 8)	Scrub Desert (1)	High Desert Grasslands (2)	Shrub Woodland (6)	Grassy Woodlands (2)	Forest (10)
Fire Management Unit	1 & 2, RB	2, RB	2, RB	2, RB	2, RB	2, RB
Fine Dead Fuel Moisture (fuel particles <0.25" in size and measured in % of moisture)	Unlimited in non developed areas > 5% in developed areas	Unlimited in non developed areas > 5% in developed areas	> 5%	> 5%	> 5%	> 5%
MFWS (mph)	Unlimited in non developed areas < 8 mph in developed areas	Unlimited in non developed areas < 8 mph in developed areas	0 to 8	0 to 8	0 to 8	0 to 8
Live Fuel Moisture (%)	n/a	n/a	>100	n/a	>100%	>100%
Slope (%)	n/a	n/a	n/a	>25% ONLY in secure locations	>25% ONLY in secure locations	>25% ONLY in secure locations

The Legend is the same as Table II-6 in Alternative B

*RB = Research burns can be conducted in all FMUs to meet natural or cultural resource objectives. The above parameters are the same as Alternative B except that they are applied to research burns in addition to wildland fire and prescribed burns.

Alternative Eliminated from Further Study

Full Suppression

Concern about (1) safety of visitors, particularly backcountry campers and staff, (2) irreplaceable or fragile cultural and natural resources, (3) value of developments and commerce, and (4) the spread of fire to neighboring properties could dictate a policy of full suppression. This alternative would preclude prescribed and wildland fire use throughout the park. Hazard fuel reduction would be accomplished strictly by non-fire means such as mechanical thinning, mowing, and herbicide treatments to the extent practicable. The difficulty of establishing effective fuel reduction treatments over large enough areas increases the probability that fires may be large with significant impacts.

Reason for dismissal: High-intensity, widespread fires resulting from fuel build up could delay suppression actions, jeopardize the safety of visitors, fire fighters, and staff, and incur very high costs associated with evacuation, suppression, stabilization, and rehabilitation. In addition, it is NPS policy to use fire where it occurs naturally to benefit fire-adapted plant communities reduce fuel loads to safe levels. Under a Full Suppression Alternative resources could be stretched to ensure the safety of visitors, park staff, and firefighters under extreme conditions, and may not be available if conditions or fires in other regions are deemed a higher priority. Staff dismissed the Full Suppression Alternative from further consideration because of negative long-term effects on safety, park values, and natural resource health.

Summary of Reasonable Alternatives

Reasonable alternatives are those that feasibly meet the purpose, need, goals, and objectives of the park. In the short term, Alternative A limits damage to park developments. Over the long term, fuels have, and will continue to buildup jeopardizing park resources. Alternative B will lower fuel levels in the park, and allow fire to return more quickly to Big Bend landscapes. There is no guarantee however, that wildland fires burning at moderate intensities will not significantly change landscapes, views, and resource values for considerable time. In addition it may be difficult to control fire even burning under prescriptions should weather change unexpectedly. Alternative C, like Alternative B, returns fire to the wilderness areas of the park. However, Alternative C also provides a research platform for allowing a gradual introduction of fire into sensitive park ecosystems. Attention to safety, visitor experience, and making decisions based on science promoted the IDT to select Alternative C as the preferred alternative for fire management in the park. The uncertain nature of fire and weather mean that while every effort is made to reduce risks, there is no guarantee that large fires will not occur while scientists and managers determine the best approaches to reintroducing fire across the park.

Table II-5 summarizes important features of each retained alternative described above and the effectiveness of these alternatives in meeting the FMP purpose, need, goals, and objectives. Table II-5 reviews impacts of alternatives over the eight impact topic areas staff determined the FMP must address. Each of the retained alternatives contains a different mixture of the same elements: suppression, prescribed fire, wildland fire use, and non-fire fuels treatments for resource benefit. There is no way to specify exactly how much of each strategy would apply if any one of the alternatives were selected, because the “amount” of each fire form depends on weather, administrative contingencies, and chance ignitions.

Environmentally Preferred Alternative (NEPA Sections 101 and 102)

The goals characterizing the environmentally preferable condition are described in Section 101 of the National Environmental Policy Act (NEPA). NEPA Section 101 states that “...it is the continuing responsibility of the Federal Government to ... (1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations; (2) assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings; (3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences; (4) preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety of individual choice; (5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life’s amenities; and (6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.”

Alternative A allows the least amount of fire on the landscape. Fuels to continue to buildup increasing the risk of high-intensity, widespread, and stand-replacing fires. The consequences of such fires are likely to cause adverse long-term effects to natural resources and potentially permanent effects to historic and cultural resources, negatively impacting all of the NEPA criteria listed above.

Alternative B allows more fire at higher intensities on the landscape than the other Alternatives and while quickly moving the park to receiving natural ignitions, the short-term effects may be negative and greater than public opinion would tolerate. Cultural resources, natural resources, and aesthetically pleasing environments are most at risk under Alternative B while recycling of renewable resources is most enhanced under this Alternative.

Using the goals above, Alternative C is the environmentally preferred alternative. Actions proposed under Alternative C are those most likely to safely provide the foundation for ensuring landscape and ecosystem health over the long-term without undue adverse effects to aesthetics, resource use, and historic, and cultural resources. Cultural resources including historic sites will be protected as for Alternative B. Valued natural resources will undergo renewal however, based on the results of research burns. Alternative C best meets conditions (1) through (5), with condition (6) best met by Alternative B.

The Progressive Fire Use designation acknowledges that uncertainty exists about how to safely allow fire to assume its natural role in the Chisos while protecting valued ecological resources and views. Park staff proposed small burns to gather data, repeat treatments, and then apply results in the Chisos Mountains as a method for developing their management trajectory for this area. This alternative accommodates concerns about safety, the needs of visitors, a scientific approach to reintroducing fire, and maintaining resources for the long-term. Thus, Progressive Wildland Fire Use becomes Big Bend National Park's proposed preferred alternative and environmentally preferred alternative.

Table II-8: Major Characteristics of Fire Management Alternatives

Characteristics	Alternative A: No Action	Alternative B: Full Wildland Fire Use	Alternative C: Progressive Wildland Fire Use
1. Management direction	Prescribed fires reduce fuels around developments. Suppression elsewhere minimizes short-term risks to property and resources. Long-term risks increase with fuel buildup.	Prescribed fires around developments, cultural resources, sensitive habitats. Wildland fires considered natural and needed. Allow low to moderate intensity fire where safe. Accept risk of short and long-term effects due to fuel buildup.	Prescribed burns as for Alternative B. Acknowledges uncertainty about how to allow fire to resume its role, especially in the Chisos. Adaptively manage wildland fire with data from research burns (RB).
2. Wildland fire use	Current decision criteria have greatly limited wildland fire use.	Allow low and medium intensity wildland fires to burn within prescriptions.	Same as Alternative B.
3. Suppression of wildland fires *	Most wildland fires suppressed based on strict criteria that govern decisions following ignitions.	Suppress around infrastructure and cultural resources; limit suppression as risks from fuels are reduced.	Suppress around infrastructure and cultural resources; possibly less suppression as fire effects understood.
4. Prescribed burning program	Burn around infrastructure to reduce fuels.	Burn around infrastructure, cultural resources and elsewhere in the park to allow safer wildland fire use and achieve resource benefits.	Burns around infrastructure and cultural resources to reduce fuels and RB to collect knowledge of fire effects. Requires pre and post-fire monitoring.
5. Fuel reduction	In all FMUs.	Same as Alternative A.	Same as Alternative A.
6.Planning	Current planning is adequate.	Survey fuel loads, identify where wildland fire can burn safely for resource benefits, and where prescribed burns or other treatments are needed to precede wildland fire.	As for Alternative B. In addition, identify questions to be answered by research burns. Long-term funding for pre-fire, post-fire of research burns, to record and assess fire effects.
7.Staffing levels	Use existing staff.	Add and train staff to manage expanded prescribed and wildland fire use. Additional coordination and interpretation requires additional time, cost and resources.	Similar to Alternative B. In addition, staff with specialized expertise are needed to conduct or assist with research burns in sensitive habitats.
8. Cooperative agreements with park neighbors	Suppress fire within 1 mile of park boundaries. Honor existing agreements with neighbors. Continue suppression rather than broader, long-term safety, or ecosystem health.	With neighboring landowner's permission, allow fire to be contained at natural boundaries such as river, cliffs or roads. Increase outreach to local and broader publics on resource and safety benefits of flexible boundary agreements.	Same as Alternative B.
9.Fire-effects monitoring	Maintain current levels of monitoring.	Increase post-fire monitoring of larger areas as more wildland fire use is allowed.	Requires most monitoring; detailed pre-fire and post-fire monitoring of research burns; post-fire monitoring of natural ignitions.

Table II-9: Effectiveness of Alternatives in Meeting Goals and Objectives

	Alternative A No Action	Alternative B Full Wildland Fire Use	Alternative C (Preferred) Progressive Wildland Fire Use
Major Features	FMU 1: Effective use of prescribed burning and non-fire treatments to reduce fuels around developments. FMU 2: Not effective in reducing fuels or allowing ecosystem processes. Initial wildland fire use decision criteria (go/ no-go) results primarily in suppression.	FMU 1: Same as No Action. FMU 2: Most effective in allowing more fire on the landscape. Allows most fire; extends fire to natural barriers along park border using pre-determined agreements with neighbors. There is confidence that fire effects will not cause adverse effects longer-term even if these effects are unknown. Fire effects will be monitored.	FMU 1: Same as No Action. FMU 2: Similar to Alternative B but benefits achieved over longer-time frame. Special care in Chisos. Staff learn of fire effects through research burns providing greater protection for unique habitats, cultural resources, rare and threatened species.
Goals & Objectives			
1. Protect life and property	FMU 1: Effective in reducing fuels around infrastructure. FMU 2: Suppression and subsequent fuel accumulation elsewhere in the park increase the long-term risk of high-intensity, widespread fire.	FMU 1: Same as No Action FMU 2: Effective. Increases risk to firefighters and property in the short term with more, larger, and hotter fires. Reduces hazardous fuels long-term.	FMU 1: Same as No Action. FMU 2: Effective over a longer time frame than (B). Research burns builds knowledge to allow wildland fires in the longer-term.
2. Reintroduce fire to accomplish natural resource goals.	Least effective. Suppression is the usual outcome for most wildland fires in park.	Effective. Fire can burn across much of the park. However, fuel loads in the Chisos may result in long-term negative effects.	Effective. Incrementally reintroduces wildland fires and builds knowledge about fire effects on natural resources.
3. Apply fire to meet cultural resource goals.	Not effective. Most fires suppressed leading to buildup of fuels.	Effective. Reduces fuels across the park and reduces risk longer-term. Assessment of sites required to determine risk and treatments.	Similar to Alternative B. Most effective. Offers greatest flexibility in meeting cultural resource goals in the short and long term. Research burns may provide clues to protecting cultural resources.
4. Minimize unacceptable environmental impacts to cultural and natural resources.	Tight prescriptions have not controlled all fires. Fuels continue to increase as does the probability of high-intensity, widespread fire in the Chisos.	Somewhat effective. Less restrictive go/no-go decision criteria enables a range of responses to risk. Post-fire monitoring builds knowledge of fire effects.	Most effective. Similar to Alternative B but monitoring is pre and post-fire. Builds better knowledge of fire effects for longer-range natural resource decisions and protection of cultural resources.
5. Manage fire	Effective in meeting legal and	Effective. New agreements allow variable	Same as Alternative B. Monitoring results

	Alternative A No Action	Alternative B Full Wildland Fire Use	Alternative C (Preferred) Progressive Wildland Fire Use
cooperatively with neighboring agencies and landowners.	political agreements. Existing agreements with Mexico and the state of Texas require suppression within one mile of park borders without considering terrain or vegetation. No incentive to improve safety, cost effectiveness or natural resource outcomes.	boundaries based on natural features improving safety, making better use of fire-fighting resources, with landscape and ecosystem wide benefits. Fuels will be reduced over time with more wildland fire. Neighbors can share ownership of park successes.	from research burns may lead to greater interest by neighbors in cooperative management of natural resources.
6. Coordinate fire activities within all park divisions, with concessionaires and the public.	Successful communication is dependent on administrative actions and follow-up within the park.	Same as Alternative A.	Same as Alternative A.

Table II-10: Impact Summary

Overview	Alternative A No Action	Alternative B Full Wildland Fire Use	Alternative C Progressive Fire Use
<p>1. Life and Property: <i>Issues-</i> Fire is an effective tool for reducing hazard fuels, but it is also a threat to the public, firefighters, park staff, and developed areas. <i>Plan overview</i> – Safety is the highest consideration. The fire management plan dictates actions when life and property are threatened. Agreements with agencies and neighbors can improve safety, cost-effectiveness and reduce damage to natural resources.</p>			
<ul style="list-style-type: none"> • Create safety: reduce fuels; safe egress is needed from the Basin. • Cooperative agreements can improve safety, reduce firefighting costs, and provide natural resource benefits. • Agreements also create a greater need for collaboration, education, and shared policies to managing fire. 	<p>Long-term minor to moderate adverse impacts to life and property from by allowing fuels to increase. Suppression of fire under extreme conditions in rugged terrain poses direct, moderate to major adverse risks to firefighters, hikers and visitors in the Chisos Basin. Fire occurrence and history of effects is limited but no impairment has occurred to date from fire.</p>	<p>This alternative may expose firefighters to more fire and risk than other alternatives. While firefighters and the public may initially be exposed to greater risks; adverse impacts ranging from minor to moderate intensity over the short-term; these risks decline as fuels are reduced providing minor to moderate long-term benefits. Alternately, more exposure to fighting fire increases staff expertise leading to long-term moderate beneficial effects on life and property.</p>	<p>More burning builds a skill base; research builds a database with potential to provide long-term moderate to major beneficial effects on life and property. Conducting research burns would involve short-term minor to moderate direct adverse risks. Activities associated with research burns improve the skill base in the park and provide a platform for adaptive management, a long-term moderate to major beneficial effect in reducing risk to life and property.</p>
<p>2. Visitor Experiences: <i>Issues-</i>Burning areas, closed roads and smoke may deter visitors, but the fire program also provides opportunities to show how fires are essential to natural processes. <i>Plan overview</i> –More prescribed and natural fire will reduce the likelihood of destructive high-severity fire. Communication will be increased throughout the park and area to limit inconvenience from fire, and increase interpretive opportunities.</p>			
<ul style="list-style-type: none"> • Negative perceptions of fire exist when humans are inconvenienced. • Interpretation helps humans think long-term about ecosystems. 	<p>Suppression retains the status quo. Prescribed burns occur outside peak visitation times minimizing disruption. Over the long-term Alternative A increases the probability of, high-severity fire in the Chisos. Suppression of such a fire would create direct and indirect long-term adverse impacts to visitor resources and park aesthetics.</p>	<p>More wildland fire would result in greater direct short-term minor to moderate adverse impacts to visitors as they experience road closures, smoke and limited access to the park. Reduction of fuels in the Chisos minimizes the threat of high-severity fire. Greater interpretive efforts by park staff would provide long-term indirect beneficial effects as visitors support policies that encourage natural fire regimes in park ecosystems.</p>	<p>Effects of Alternative C are beneficial and minor over the short-term. Scientific evaluation of research burns applied to fire policy and interpreted for the public, provide a touchstone enabling visitors to weigh immediate direct adverse effects with potential long-term beneficial effects on ecosystems. Benefits to visitors are expected to be greatest under this alternative.</p>
<p>3. Local Economy: <i>Issues-</i> Fires may dissuade visitors or attract them. Local merchants and firefighters benefit from fire operations but may also lose patronage if visitors choose alternate destinations. <i>Plan overview</i> – More routine fire events provide income on a regular basis. Fire events can be used as opportunities for interpretation.</p>			

<ul style="list-style-type: none"> • Fire activities are important income for this area. • Merchants, firefighters in Texas and Mexico benefit. Visitors may be attracted or repelled by fire activities. 	<p>Minimal disruption improves gains from visitors. A high-severity fire would give merchants and firefighters a one-time windfall. Visitors may go to a greener place.</p>	<p>Alternative B would result in short to long-term beneficial effects to seasonal firefighters and local merchants as fire frequency increases in the park. Benefits are expected outside fire season for prescribed burns and during fire season for natural ignitions, extending the period of benefits to firefighters and merchants.</p>	<p>Under Alternative C beneficial impacts to the economy would range from minor to moderate depending on fire frequency, duration, intensity and size, and whether permanent park staff can meet staffing and additional seasonal firefighter needs.</p>
<p>4. Vegetation: Issues-Fire occurs in many plant communities stimulating diversity, thinning and regeneration; large-scale fire retains the mosaic pattern of vegetation. Suppression has increased fuels and the likelihood of damage from high-severity fire. Fire is an integral part of wilderness-an area also favored by park visitors. Exotics respond more vigorously than many natives to fire and may displace them. <i>Plan overview</i> –Allowing natural and prescribed fire at low and moderate intensities reduces fuels and provides greater control over fire timing, location and effects limiting threat of large-scale fires. Interpretive actions warn visitors of the dangers of wilderness under extreme weather conditions and an evacuation plan exists for the Basin. Fire is being considered as part of a sequence for controlling exotics especially saltcedar, buffelgrass, and Bermuda grass.</p>			
<ul style="list-style-type: none"> • Fire adapted plant communities benefit from fire and enhance habitat for wildlife. • Unique habitats - all respond differently to fire. • Research fires will be small. • Fire is an integral part of wilderness Suppressing fires in wilderness is costly. Risks to visitors will increase with increasing fuel loads. • The effectiveness of fire as a management tool for exotics varies by plant species. 	<p>Beneficial direct short-term impacts for protecting habitats, wilderness. High severity fire in the Chisos leads to moderate to major adverse impacts over the short-term. Long-term the effects are unknown but no impairment.</p>	<p>Minor adverse short-term impacts from fire with moderately long-term beneficial effects to vegetation communities and fuel levels as natural fire regimes are restored. Applying mitigation measures to burned areas of exotics provides short-term beneficial effects.</p>	<p>Short-term adverse minor to moderate impacts are expected from vegetation loss with direct long-term beneficial effects to improving diversity in plant species and community structure.</p>
<p>5. Threatened and Endangered Species: Issues – Fire can injure or kill rare species but may also aid in the recovery of others. <i>Plan overview</i> – Sensitive prescriptions and conservation measures will reduce fuels providing greater protection for listed species except under extreme fire conditions.</p>			
<ul style="list-style-type: none"> • The park contains many rare, endemic, threatened or endangered species. • Some habitats experienced more fire in the past. 	<p>Effects to plant and animal species are minimized by suppression-adverse effects over time as fires are likely to be more widespread and burn hotter. Removal of habitat is likely to cause greater loss than direct impacts of fire to animal species.</p>	<p>More low and moderate intensity wildland fire and additional prescribed burns lessens fuels and the likelihood of adverse effects to plant and animal species and habitat from high-severity fire. These are indirect long-term minor to moderate and beneficial.</p>	<p>Reduction of fuels across the park reduces fire intensity – a direct minor beneficial effect. Applying research results to manage habitats of protected species is a long-term direct beneficial effect.</p>

<p>6. Cultural Resources: Issues –Historic structures, landscapes and artifacts may incur fire damage. <i>Plan overview</i> –Prescribed burning and mechanical thinning will reduce fuel buildup near structures and sites. Fire will be kept away from the most sensitive sites.</p>			
<ul style="list-style-type: none"> • Historic structures contain burnable materials. Reduce fuels around CR sites. • Cultural landscapes may be defined by particular plants which need protecting or replacing following fire. • Fire may also help reduce surrounding hazard fuels and maintain the historic scene. 	<p>Suppression protects sites creating minor to moderate beneficial impacts. Impacts are likely to be localized and long-term.</p>	<p>Alternative B is likely to result in long-term beneficial effects as fuels are reduced across the park and treatments of specific sites are implemented. Effects on unknown sites cannot be easily determined but prehistoric sites that have burned previously likely will not be damaged further. Greatest risks are from suppression activities.</p>	<p>Implementing mitigative measures in conjunction with increased fire use in the park would keep minor adverse long-term impacts to a minimum.</p>
<p>7. Watershed effects: Issues- Fire can remove vegetation, burn organic matter leaving soils open to erosion until plants regrow. <i>Plan overview</i> – Allow natural ignitions to burn at low and moderate intensities limiting damage to mature trees. Research burns will identify fire dynamics and effects in particular habitats and fuel situations.</p>			
<ul style="list-style-type: none"> • Fire can remove vegetation from slopes and cause increased erosion until plants regrow. • Intense rains on steep, bare slopes after fire may lead to debris flows. • Rare plant and animal species in drainages may be killed by debris flows. 	<p>Fire management suppression impacts to watersheds in the Chisos are likely to be adverse, minor to moderate and long-term while suppression continues. The potential continues for moderate, adverse impacts to soil stability and debris flows following high-severity fire and summer monsoons. While suppression remains successful impairment is unlikely. Minor, adverse impacts are expected to watersheds in lowland deserts.</p>	<p>Under Alternative B adverse impacts to the Chisos Mountain watersheds would be minor to moderate and short-term. Minor adverse impacts from fire are likely in lowland desert areas. Beneficial impacts are expected over the long-term for watersheds in the Chisos. Extreme fire events outside prescription before fuels can be reduced would create moderate to major direct adverse impacts over the short and long-term.</p>	<p>The preferred alternative would result in long-term moderate direct and indirect beneficial effects. Low to moderate intensity research burns, assessment of fire effects and gradual reintroduction of natural ignitions based on this knowledge is expected to safely reduce fuels and preserve resources. Fire management guided by research into restoration of lowland deserts may have direct and indirect benefits to watersheds over the long-term.</p>
<p>8. Resources for the Fire Program: Issues-Moving from a suppression-oriented fire program to more prescribed and fire use will require additional resources. <i>Plan overview</i> – The fire program is considering the staff, training and equipment needs to allow the preferred alternative to be implemented successfully.</p>			

<ul style="list-style-type: none"> • The availability of skilled seasonal or permanent staff and equipment determines whether fire program activities can be planned and implemented. • The current fire program focuses on reducing fuels around developments. Action alternatives require extra resources for more prescribed burning, wildland fire management etc. 	<p>Under the current management direction there would be long-term minor to major adverse impacts to park values and resources as existing staff are called to meet increasing numbers of emergency fire situations.</p>	<p>Under Alternative B, more frequent and larger natural fires, and more fuels reduction treatments are expected to tax existing staff, seasonal firefighters, engines, and equipment. Shifting from suppression under Alternative A to more routine fire events will require reassignment of staff priorities and/or hiring of additional staff with sufficient engines, equipment and safety training. Depending on how resource needs are met, these changes could be minor to moderate adverse (if met within the park) or beneficial (additional hires from outside the park) with direct and indirect long-term effects to park resources.</p>	<p>Under Alternative C, impacts to resources for the current fire program and staffing levels are likely to result in moderate direct and indirect adverse effects. The expected increase in actions cannot be met without additional input from scientists for research burns, cultural resource specialists for protection of specific sites, knowledge of fire effects across the park (requiring pre-monitoring and post-monitoring (whenever possible)), and additional permanent or seasonal staff. These requirements are likely to instigate long-term changes in the park fire policy to enable adaptive management of resources and values.</p>
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Chapter III : Affected Environment

This chapter provides information about the park necessary for understanding the effects of the fire management alternatives analyzed in Chapter IV. Appendix D lists the scientific names for plant and animal species mentioned throughout the text.

Impact Topic (1): Life and Property.

Big Bend National Park is located Brewster and Presidio rural counties in the prominent southward bend of the Rio Grande River. The mid-channel of the 118 miles of river bordering the park also forms the international boundary with Mexico. Two large preserves in Mexico, Maderas del Carmen and Canyon de Santa Elena enlarge the protected area of the park, and allow movement of species that do not respect human imposed property lines including domesticated livestock. One mile from the southwestern border is the Big Bend State Ranch Park and to the northeast the Black Gap Wildlife Management Preserve. Ranches and ranchettes abut the northern and northwestern boundaries of the park. Many are absentee landowners making cooperative fire management challenging. Gateway communities are slowly growing, attracting retirees and businesses that provide for visitors and these service centers need to be kept abreast of park developments. Several right of ways and service utility easements cross the park.

There are three main developments providing services to visitors within the park. The Chisos Basin, Rio Grande Village, and Panther Junction provide interpretive facilities, lodging in rooms, campgrounds or park your own trailer. Primitive roads make the backcountry accessible by 4-wheel drive and hikers can stagger to 14 campsites spread throughout the Chisos. There are many roadside exhibits with signage, pullouts and historical sites with burnable materials. Staff housing is concentrated at Panther Junction with maintenance facilities and offices for the park. Fencing and grasses supporting cattle along the park boundary, and wooden utility poles, could all be damaged by fire. Prehistoric artifacts have probably been burned many times and are more at risk from suppression activities than fire itself. Rugged terrain in the Chisos, ample fuels, few roads, and wilderness create challenges in the event of fire.

Safety issues

There have been 31 prescribed fires in the park since 1980. Two have escaped. The Casa Grande fire in 1999 led to fire shelter deployment, and atypical wind conditions during a small burn at the Big Bend gambusia ponds led to the loss of some cottonwood habitat. Lessons learned on these fires have been incorporated into new prescriptions and training in the park. Mistakes signal caution, but can also offer opportunities for learning and may provide some unexpected benefits such as establishment of cottonwood seedlings in ash beds near the gambusia wetlands. Buildup of fuels guarantees that sooner or later a natural ignition, human carelessness, or prescribed fire may escape, and the costs could be very high. Since 1980 there have been 239 lightning ignitions burning 19,021 acres. Clearly the park does burn but burning successfully in areas with high fuel loads, proposed under alternatives B and C, will require skill and experience. Given the safety issues, the fuel loads and value to the public, it is suggested that training and assistance be provided by a 'Hot Shot' fire crew for initial prescribed burns in the Chisos. The 'Hot Shots' training of the entire fire program staff would be a cost-effective way to meet future difficulties of burning in areas with high fuel loads, wilderness designations, and obtaining local expertise in a remote park.

There is a single road into and out of the Chisos Basin which could make evacuations difficult in the event of a large fire in the area. An evacuation plan has been prepared (described in Chapter II) and prescribed burns along Green Gulch will lower fuels and reduce the possibility of fire from vehicular traffic entering the Basin. Safe evacuation would be a challenge from the high Chisos where a wilderness designation means minimum impact suppression techniques (MIST) are required such as no motorized vehicles, use of hand tools only, and no airborne retardant drops. Superintendents can override these provisions and allow higher impact suppression methods when they perceive threats to life or property.

There are some provisions in place to safeguard visitors to the high country; hiker permit tags show fire conditions during high to extreme fire danger; rangers may be posted at trail entrances to talk with every visitor entering the high country and ensure they are aware of the danger; no smoking or open campfire signs may be posted during periods of danger; and, the Superintendent may close the area to protect people from possible fire dangers. Escaped camping fires were determined as the cause of the Blue Creek fire and Laguna Meadow fires. The measures taken to reduce fire risks are usually in association with fire precautions taken throughout the entire Lincoln Zone of the southwest area. Figure III-1 shows the peak of overnight campers in the Chisos occurs in March and early April coinciding with school and public holidays. Fourteen campgrounds are used in the Chisos with Juniper Flat (471), Colima (398), and Boulder Meadow (384) most popular. There were 3,639 permits issued in 2003 and campers stayed one or more nights.

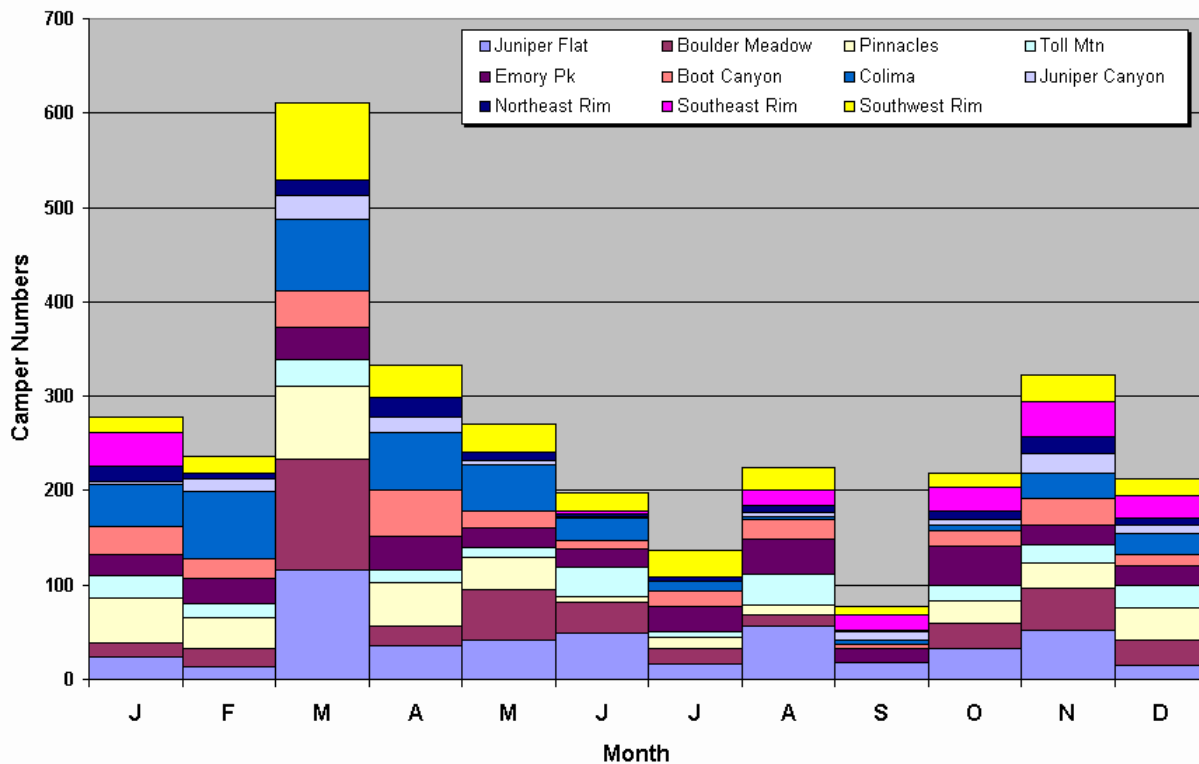


Figure III-1 Number of Campers, staying at least one night in the Chisos in 2003

Human caused fires are most prevalent during peak visitation times including spring break and Easter from March through May (71%-75% of fires), and during September vacation period (40% of fires). The percent of lightning caused fires ranges from 47% in April to a high of 83% in July falling to 56% in October. Most ignitions during November and December are caused by humans. Most fires are small. Of the recorded 543 fires in the park's history, 67 % are less than 1.0 acre in size and 94% are less than 100 acres. Large fires (>1000 acres) are few (9 recorded) and have been caused by lightning occurring in shrub desert with significant grassy understory. The greatest risk of fire coincides with peak visitation during the college vacation in March and Easter vacation in April when lightning strikes dry vegetation prior to the summer monsoon.

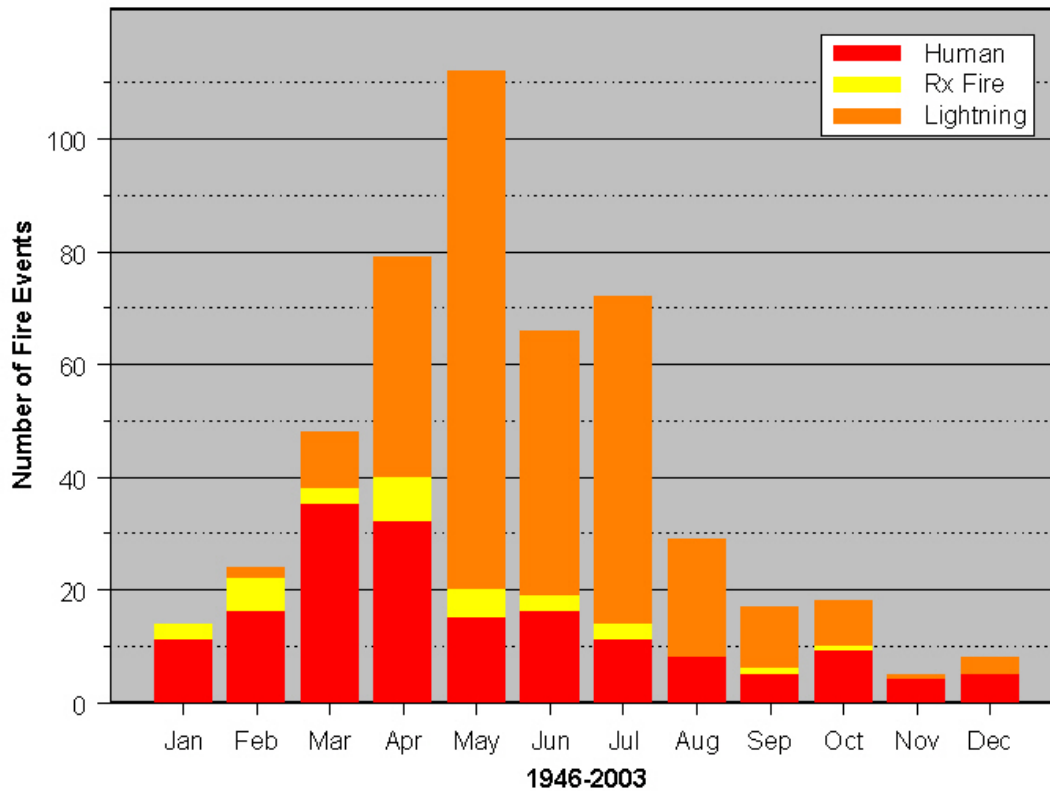


Figure III-2 Cause and Number of Documented Fires at Big Bend National Park.

Cooperative agreements with neighbors

The park seeks to collaborate with neighbors to develop a coordinated response to managing fire in the interest of safety, cost-effective use of firefighting resources, and better management of natural resources. Formal agreements outlining control of fire currently exist between the park, federal, state, other agencies, private landowners and Mexico (draft 1999). Under these agreements, the park agrees to suppress fires within approximately one mile inside the park border. The park also suppresses incoming fires because of its mandates to protect valued resources and because it has the equipment. Issues of safety, cost, and responsibility increase with expanded wildland fire use and prescribed burning under Alternatives B and C. Currently, fires must be controlled along arbitrary property lines which are drawn without regard to topography and vegetation conditions. The park proposes in the future to suppress fires at barriers such as roads, the river, and cliffs to improve safety for firefighters, cost-effectiveness of firefighting resources, and provide benefits for natural resources. Contacting neighbors to develop these new agreements will be an ongoing process. Special provisions will be made to include Mexican preserve managers in these negotiations as they too must deal with fires resulting from carelessness along the river corridor.

Challenges in identifying absentee landowners in gateway communities, and obtaining approval and funding for Mexican managers to travel to the park were noted at an IDT meeting at the park January 5, 2004. The impetus for contacting private landowners is that many neighbors are absentee landowners, most have settled from elsewhere and must learn behaviors that foster protection of resources, and all have an impact on the vegetation particularly around the northern and western peripheries of the park.

The difficulty of locating the many neighbors led staff to pursue development of boundary agreements with the largest neighbors and maintain the one-mile suppression buffer where there are many divergent viewpoints on proposed fire-suppression strategies, or where landowners cannot be easily contacted. Efforts to contact additional neighbors will continue when resources and time allow.

Fire Program Resources to Protect Life and Property

These issues are discussed under impact topic (8). The fire program has the capacity to handle current prescribed fires and small fires of short duration. To protect life and property under extreme fire conditions, the incident commander would request additional resources from the region and/or national office. Larger fires burning for longer periods on a routine basis, are possibly outside the capacity of the park current capacity to monitor and protect effectively. Additional support would be required from other agencies or the park would fill needed permanent and seasonal positions. The need for and type of positions are outlined under impact topic (8).

Impact Topic (2): Preservation of Visitor Experience

Approximately 300,000 people travel long distances annually to visit Big Bend. These visitations are testament to the unique experiences the park offers. Visitors can view the sheer canyon walls and park geology on a raft trip along the Rio Grande, abandon civilization in seemingly endless expanses of agave and yucca-strewn Chihuahuan Desert scrub, and be cooled by the oak-pine forests and grasslands of the Chisos - without even leaving the 110 miles of paved roads. Numerous hiking trails provide more energetic visitors with opportunities to experience these habitats more intimately and seek a glimpse of wildlife, view clear night skies, examine old mercury mines, and ponder life of former ranchers and merchants at historical homesteads. Exploring by raft or boat reveals the towering cliffs of the Boquillas, Mariscal, and Santa Elena Canyons and allows fishing in the Rio Grande. Naturalists appreciate this park. The mountains and riparian system that provides a vital corridor for migrating birds, mammals and the dispersal of plants between two countries and three interconnected mountain systems. The relative isolation of the park and its connection to other large protected landscapes has allowed the perpetuation of many rare and endemic species. The park botany research site currently lists 89 projects (12 Sept, 2004).

Visitors may camp within the park at the Rio Grande Village and Chisos Basin campgrounds, various primitive sites off roads and 14 designated primitive campsites in the high country of the Chisos. Motel accommodation and meals are available at the Chisos Basin but demand frequently outstrips supply. Other accommodations and supplies are more readily available in Study Butte and Terlingua 15 miles away, and at the luxurious resort of Lajitas, 40 miles from Panther Junction. The average stay in the park is three days, two days longer than most national parks. Alternate destinations for visitors in the event of fire-related closures with comparable amenities are few (Big Bend Ranch State Park and Black Gap Wildlife Management Area). The long distances involved in making alternate plans makes it imperative that park staff disseminate timely, accurate information forewarning visitors of potential inconveniences.

Communications about fire related activities will increase under the action alternatives. The park utilizes web site, radio, local press, signage, notices at visitors centers, adjoining agencies and local communities of any planned and unplanned road closures or other fire activities. Such notices will attempt to reduce inconveniences, promote safety, and provide information to aid understanding about fire wherever possible. Fuel buildups in areas of the park mean more fires are likely in the future. Staff perceive interpretation of fire events as playing a key role in the publics' acceptance of natural fire in the landscape. The larger interpretive center planned for Panther Junction will provide space for comprehensive treatment of fire issues at the park.

Impact Topic (3): Local Economy

The park lies within the counties of Brewster and Presidio. Median incomes for Brewster were 70% of the national average with Presidio residents making just 38% of the national average. Approximately 28% of Brewster residents live below the poverty line and 45% of Presidio residents (GMP, 2003). Any outside income clearly makes a positive difference for these residents. In 2000, 44,627 visitors stayed in concession lodging and 10,473 in the concession campgrounds of Rio Grande Village, Rio Grande Village Trailer Park, Cottonwood Campground, Chisos Basin, and the many backcountry sites (GMP, 2003). Lodging is also available in the nearby towns of Terlingua, Study Butte, Lajitas, Presidio, Marathon and Alpine. The park represents a critical source of income for workers in these areas and dollars earned have multiplier effects in local economies.

Gateway towns surrounding the park are slowly growing. Subdivision of the Terlingua Ranch has led to more settlements on 20-40 acres along the dry western boundary of the park and in the townships of Study Butte and Terlingua. Some residents seek solitude, others community, but all are appreciative of the vistas of the park. The local economy is closely tied to visitation of Big Bend, with merchants supplying food, fuel, beds, souvenirs, and artisan wares from across the southwest. Some trained residents are recruited for firefighting when needed, others provide research and data collection when funding is available, and some support the park as volunteers. Vegetation is sparse around Terlingua presenting few fire hazards, but the growing number of landowners and seasonal visitors will require coordinated efforts to ensure inclusion in planning efforts and timely notification of fire program activities.

Los Diablos are US-trained Mexican firefighters employed on an “as-needed” basis to protect resources in both Mexico and the US. The park’s first recruitment and training of Los Diablos occurred in 1990, with the second in 1997. There are currently 32 trained Diablos. Firefighting provides important income for this group who frequently spend their paychecks on American goods.

Prior to closure of the United States-Mexico border at small crossings in and near the park along the Rio Grande, the web of economic benefits from the park extended across the border into the states of Chihuahua and Coahuila. For many visitors a trip to Big Bend included a visit to Boquillas, the Mexico township across from Rio Grande Village to eat at one of several restaurants and purchase arts and crafts. Mexican farmers also grew produce destined for restaurants in the U.S. at Study Butte, Terlingua, and Lajitas. Many of these small-scale entrepreneurs are now deprived of a livelihood as the nearest legal border crossing is 10-11 hours round trip from Boquillas via Del Rio, to Rio Grande Village. While the Immigration and Naturalization Service (INS) has created dispensations for Los Diablos, the Mexican fire crew, to cross at Boquillas, and is considering allowing other Mexicans dispensation to cross into the United States, border closure has created great economic hardship in an area with few alternate livelihood opportunities. Without access to legitimate income-generating activities, local people are increasingly forced to live on a subsistence basis, seek other ways to generate income, or migrate elsewhere. Since the border closure, there have been increasing incidences of theft from campgrounds, growth of illegal drugs along the river, and drug trafficking. There is also an incentive for arson to create jobs through firefighting.

Impact Topic (4): Vegetation

Big Bend lies in the middle of the Chihuahuan Desert flanked by rainshadow inducing mountains on the east and west. Low latitudes, and a 40-mile wide sunken graben in this basin and range landscape accentuate aridity and heat. The high elevation canyons and bajadas of the mountains, ephemerally filled arroyos and depressions, expanses of lowland deserts, and permanent waters of the Rio Grande support 1200 plant species within the park. This diversity is further shaped by limestone and igneous soils,

extremes in rainfall from 4 inches in the low desert to above 16 inches in the Chisos, and temperatures from 100 degrees F to freezing. Out of the estimated 1000 endemic species throughout the Chihuahuan Desert more than 10% (120-130) are within Big Bend NP (Brown 1994). Unusual combinations of taxa particularly in the Chisos influenced the UNESCO Biosphere designation in 1976.

The gently sloping desert floor, features this desert's signature plant, lechuguilla as well as creosote, many cactus, and perennial grasses. Plant survival on these limestone soils depends on capture and storage of predominately (65-80%) summer rainfall in succulent stems, small, resinous or velvety leaves, and deep or widely spreading root systems. Depressions support alkali sacaton and tobosagrass. Terlingua and Tornillo creeks drain western and eastern portions of the park respectively into the Rio Grande River.

The Rio Grande once carried erosive sediments from as far as Colorado. With contributions from the Rio Conchos in Mexico, the river has carved through the limestone strata to create the breathtaking Boquillas, Mariscal and Santa Elena Canyons. The same scouring action of spring floods once scattered cottonwood forests and mesquite bosques sporadically along the river. Now tamed by dams, diversions, and groundwater pumping, the slow and diminished river flows are ideal for supporting the dense stands of exotic saltcedar along the shoreline, and giantreed in the river shallows.

More than ninety percent of the park is desert. The 7800ft Chisos Mountains facilitate the growth of woodlands and forests capturing sporadic summer thunderstorms from the Mexican Gulf, and the steadier winter rainfalls driven by Pacific frontal storms. Volcanic in origin and deeply eroded, the cooler moister northern slopes and deep gullies support conifer forests of Ponderosa pine, Mexican pinyon, Douglas fir, and bigtooth maple. Deeper soils at lower elevations support drought-tolerant oak and redberry juniper and shrubs. Grasses and succulents are found on exposed southern exposures and ridge tops. Rainfed pools and seeps from percolating water meeting bedrock nurture long-spur colombine and rare leopard frogs. These mountains, although just two percent of the park, pose most challenges to the fire program because they host great diversity of species and habitats amid rugged terrain. Grazing removed grasses that carried fire; suppression allowed leaf litter, ladder fuels and dead and downed to build. Now high desert grasses have recovered, can carry fire, and will do so into heavily fueled areas. Evidence of fire-scars in juniper suggest that this landscape has been shaped by fire over long periods, and that it is an important tool for maintaining ecosystem processes (Moir 1982).

Four elements affecting the fire program are discussed here: (a) interaction between fire and the six vegetation types at the park; (b) unique habitats requiring special consideration to ensure their survival and/or restoration; (c) treatment of designated wilderness, and (d) fire-adapted non-native plants that may be aided by increased fire. Vegetation categories have been assessed for condition (estimated departure from historical fire regime under the Fire Monitoring (USDI 2003), with III representing the greatest departure from historical conditions;) fuel model, which indicates the type and rate of spread of fire expected (introduced in Chapter II), current and desired structure, and common species.

The following vegetation categories are a further development on the 1994 FMP. Work of seven researchers was considered at that time and Plumb's (1987) research merged with Wauer's (1971) to yield four formations with many subcategories. The IDT reexamined Plumb's (1993) research and created six categories in light of current fire management considerations. Bray's historical reference (1901), and Brown's work on southwestern biomes (1994, 2000) were also consulted. Figure III-3 shows vegetation categories for the FMP at Big Bend, with Figure III-4 providing clearer detail of vegetation types in the Chisos.

(a) Vegetation Categories

Floodplain/Upland Riparian

Two cover-mapping categories, Mixed Riparian and Desert Willow from Plumb (1993) formed this vegetation category. The Rio Grande with a high watertable and dependable water year round supports

considerable stands of vegetation, and although just 3% of the park, forms a vital lifeline for animals and humans. Historical photos taken in 1901 show a mostly denuded riparian corridor (Schmidley 2002). The erosive force of the spring floods kept the river clear of reedbeds and promoted scattered gallery forests of cottonwood and willow with sparsely vegetated floodplains of mesquite, acacia, screwbean, desert willow, and shrubby groundsel tree. Upstream dams in New Mexico now capture spring floodwaters. The Rio Conchos River 100 miles upstream provides valuable additional waters. Fire would have been uncommon prior to humans with lightning ignitions extinguished by high humidities and fuel moistures during summer. Understory was probably sparse. Now, fire can be supported with increased ground and ladder fuels from exotic species, which recover faster after fire than the natives. Fire is more frequent year-round from abundant human visitation and carelessness with campfires.

Upland Springs: Springs, seeps and tinjadas provide precious waters for wildlife and are found throughout the mountains and low elevation desert. They were claimed by ranchers and exotics gradually established. Now saltcedar is being systematically removed from springs and seeps allowing natives to reestablish.

Common species:

Floodplain -Big Bend cottonwood, honey mesquite, screwbean, willow, desert willow, acacia, common reed; exotics include saltcedar, giantreed, Bermuda grass and buffelgrass.

Upland springs – overstory varies with site; drooping and alligator junipers in moister sites with Emory and Chisos Oaks in less moist areas; alkali sacaton, deer muhly, blue and black grama grass understory.

This vegetation type has the following characteristics:

- Present structure: The floodplain is sparsely vegetated with dense stands on non-native saltcedar along the shore and giantreed thickets in shallow water. The historical intermittent gallery forests of native cottonwoods and honey mesquite bosques believed to exist prior to Europeans are found in small patches (Schmidley 2002). Native understory includes shrubby groundsel tree and desert willow. Introduced Bermuda grass and buffelgrass are dense where sun and moisture are present. Upland Springs dominant vegetation varies by spring; more mesic species including alligator and drooping juniper, and Graves and Emory oaks. Most saltcedar has been removed.
- Condition class: Floodplain –III; Upland springs to I- II (designation depends on whether they have they recovered from grazing impacts); Lower reaches of drainages –II; Headwaters of drainages –I
- Condition on recent burns: Wetlands: Rio Grande Village burn (2003) of moderate severity has shown high recruitment of cottonwood seedlings in ash beds. Other areas required additional plantings. Response to fire in the giantreed suggests regular burning at 5-yr intervals to reduce risk. Floodplains: Jewell fire (2002, 88 acres) between Mariscal and Santa Elena- arson set fire burned ~ 300 year mesquite bosque which is resprouting. Bermuda grass has responded vigorously after fire. San Vicente fire (2000, 27 acre) removed native overstory and saltcedar; both types of vegetation are resprouting. Upland springs: The history of exotics at springs suggests that fire may remove native overstory giving competitive advantage to more fire tolerant exotics. Other controls necessary following fire at springs.
- Fuel model: Floodplain –8 (Slow-burning ground fires with low flame lengths. The fire-supporting layer is composed of compact leaf litter, needles, leaves and twigs). Upland Springs – 3 (Fire is carried through tall grasses where one-third or more are considered cured or dead. Highest intensity of the grass fires, especially under wind.)
- Fire Cause and Frequency: Natural fire uncommon with high relative humidities and fuel moistures, wet soils. Human caused fires are common along the river.
- Insect/disease: None seen at present.
- Problem invasives: Large sections of the riparian corridor have saltcedar, with giantreed prevalent where the waters slow; buffelgrass established in upland arroyos.

Management Directions:

The major goals are to have scouring spring floods restored (beyond control of park), contain the spread of exotics and remove them wherever possible, gradually restoring native vegetation.

Floodplain: Staff are planning to contain exotics; initiate pilot restoration of natives; use fire when it occurs as part of an integrated restoration program for native species which may include sowing seed in ash beds and using herbicide to cut stumps of salt cedar; and, protect cottonwoods. Seedlings may need protection from rabbits and rodents as well as Mexican livestock, which ignore the international boundary. Saltcedar will be removed from arroyos as resources are available. Monitoring and photos will capture changes in exotic cover along the floodplain and arroyos associated with restoration projects and control of exotics.

Wetlands: Staff propose burning giantreed on a 5-year rotation to maintain endangered species habitat in selected localities.

Upland springs: Exotics will continue to be removed over time; mature native overstory species will be protected from fire wherever possible.

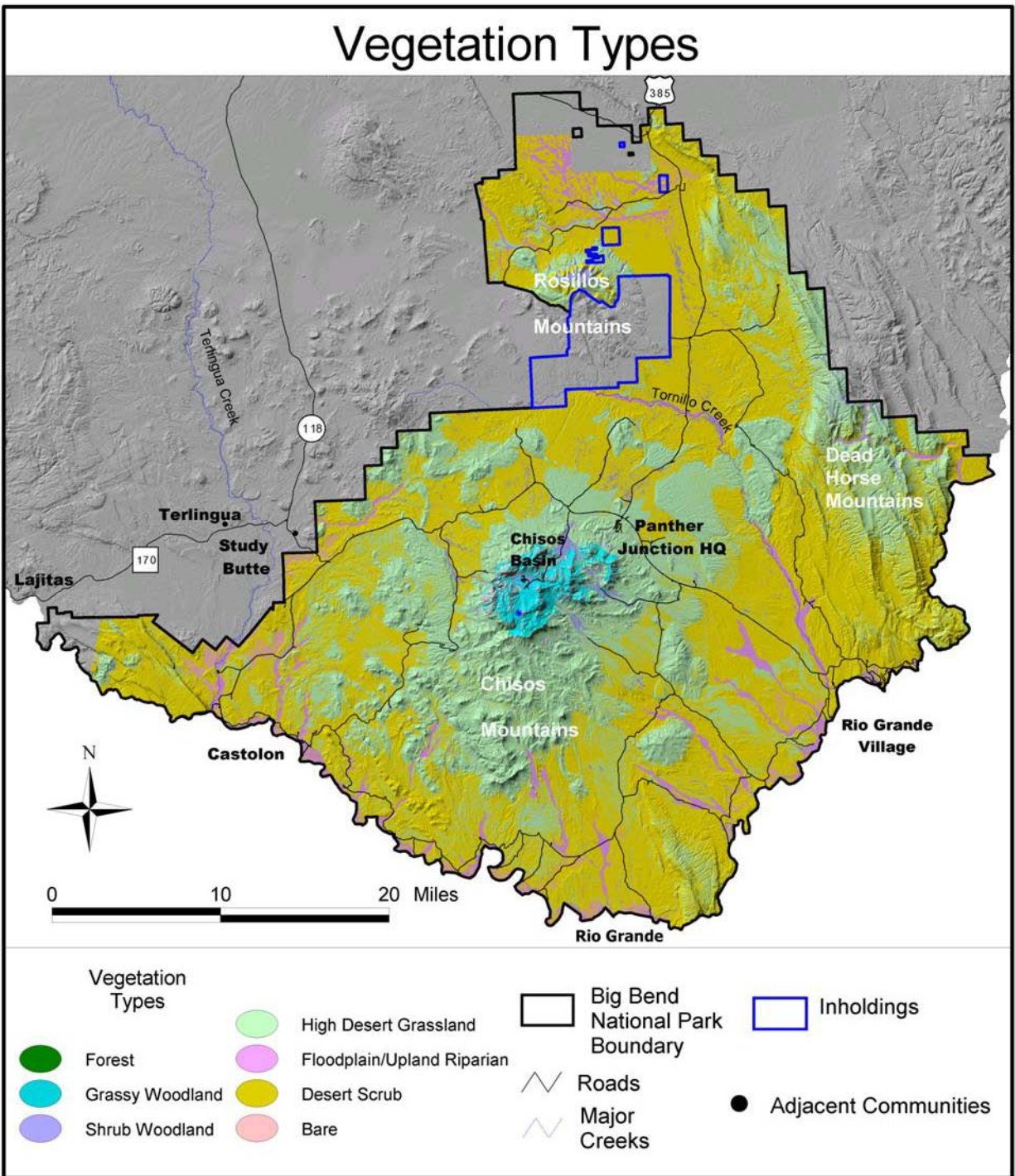


Figure III-3 Vegetation Categories under Big Bend FMP

Vegetation Types -- Chisos Mountains

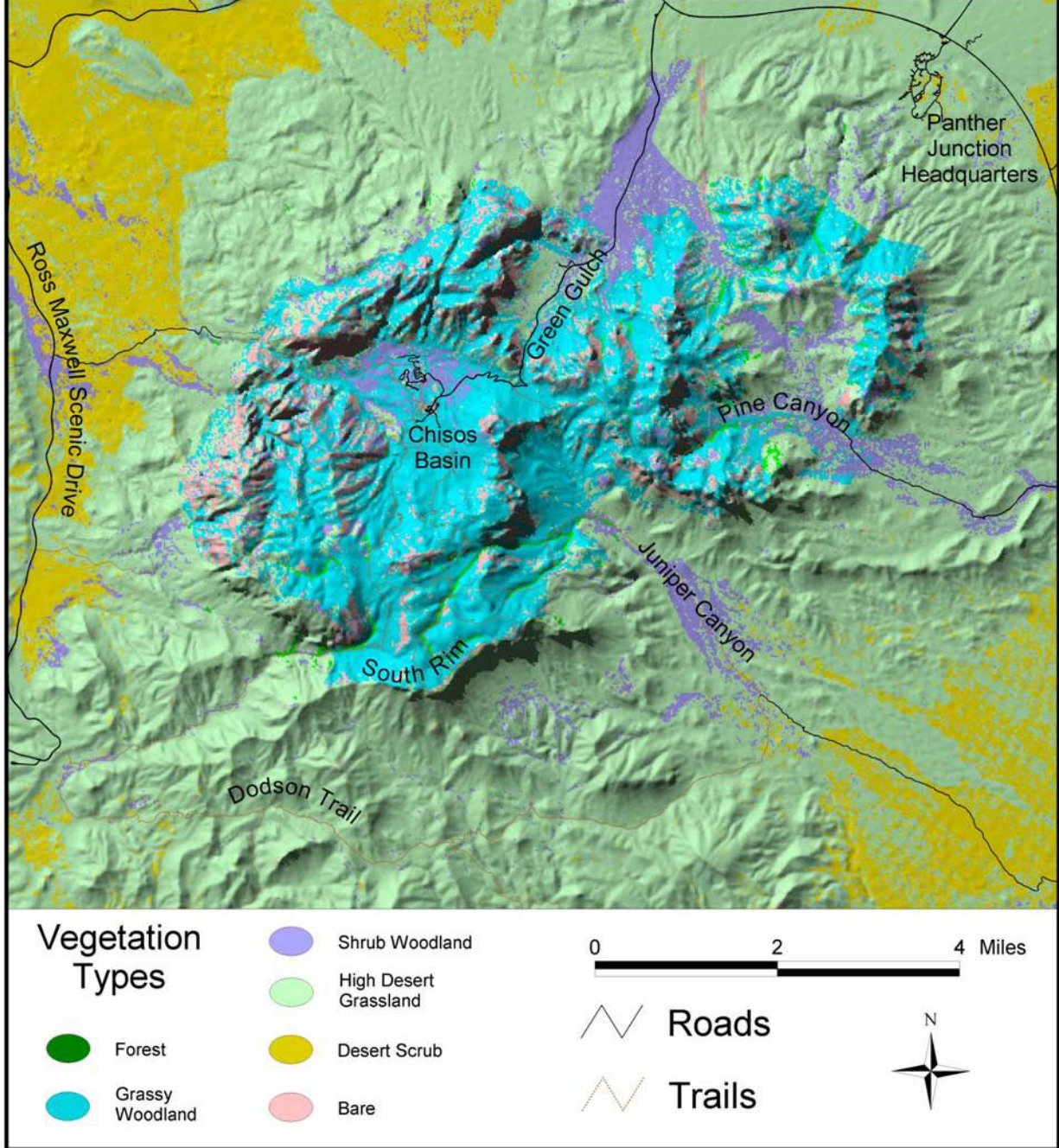


Figure III-4 Vegetation Types in Chisos Mountains

Scrub Desert:

This vegetation category was compiled from five cover-mapping categories from Plumb (1993); Creosote-Lechuguilla-Grass, Creosote-Lechuguilla-Prickly Pear, Creosote-Tarbrush, Creosote-Yucca-Grass, and Lechuguilla-Candillea-Hetchia. Desert scrub is dominated by shrubs (creosote, mariola and ocotillo) and succulents (prickly pear, lechuguilla, and Texas hetchia or falseagave). Grasses are subdominant and provide insufficient fuels to carry fire. Scrub Desert occurs over half the park between the low-lying floodplains at 1,700 ft to mid-elevation desert grasslands at 3,000 ft. Average annual precipitation of 8-12 inches falls in winter and summer (mostly) with high rates of evaporation.

Common Species: Creosote, tarbrush, lechuguilla, mariola, prickly pear, candelilla, hetchia, tobosagrass, sacaton, chino grama.

This vegetation category has the following characteristics:

- Present structure: Sparse desert shrubs, succulents and grasses. Grasses are unlikely to carry fire in this category but high winds may carry fire through shrubs. This is unlikely to be a fire maintained association because of the paucity of grasses. In the past there were more grasses including dense flats of tobosagrass on Tornillo Flat and fire may have been more common.
- Condition class: Where native shrub and succulents dominant –I (across most of the park); Arroyos invaded by exotics –II; Exotic grasses dominant –III. There is the risk of changing fire-regime adversely because these exotics respond more vigorously after fire than natives.
- Condition on recent burns: A prescribed burn in Comanche Draw, 6 miles south of Persimmon Gap in February 2003 (500 acres) showed a slight increase in grass cover from 1% in control plots to 2.5% in treated plots as a result of treatment by fire (McKernan 2003). Only one of past two years of above annual precipitation during the monsoon when grasses establish was included in results and grass recovery may be higher over the next year
- Fire Cause and Frequency: Lightning ignites fires are infrequent and usually do not carry far because of fine discontinuous grassy fuels (10-13% cover). Fire may carry through the shrub layer under high winds.
- Fuel model: 1 (Fire spread is governed by fine, porous and continuous herbaceous fuels that are almost cured. Typical of grasslands and grass-shrub assemblages and has high rates of spread.)
- Insect/disease: No problem areas at present.
- Problem invasives: Buffelgrass is colonizing arroyos that lead into the Rio Grande (Guertin 2004) converting shrub-dominated areas to highly flammable grasslands.

Management directions:

Major goals are to let natural fires burn within prescriptions and to use research burns to understand how fire may aid restoration of grasslands particularly tobosagrass and sacaton. Desert Scrub is the buffer zone to keeping buffelgrass out of high desert 'sotol' grasslands. Developing methods to aid grass establishment may help curb buffelgrass infestation. Fire at Comanche Draw shows that sites that increase moisture retention may increase recruitment of grasses in above average summer rainfall years (McKernan 2003). Options for buffelgrass areas are to suppress, or to burn and follow-up with additional controls. Experiments with and without herbicide following fire are proposed for the 1314 burn site joining highway 118, which also contains Lehmanns lovegrass. Monitoring using photos will be used to document changes in exotic cover, Warnock transects and circular plots, and, to document fire effects in natural burns and post-fire for selected prescribed burns.

High Desert Grasslands:

This is the most diverse vegetation category in the park, with the most species per unit area. High desert grasslands cover about 40 percent of the park ranging from 3,000 to 5,000 ft in elevation with scattered

plants occurring in the heights of the Chisos. Annual rainfall is 10-16 inches with most in summer. Lightning caused fires are common in this category and dependent on understory fuels. High Desert Grasslands can support large fires (>1000 acres) with sotol and yucca can act as receivers of lightning strikes and spreading fire as they roll downhill. Biological surveyor Vernon Bailey reported in 1901 that “Luxuriant grass covers almost the whole of the mountains ...” (Schmidley 2002:350) suggesting more frequent fire at low and moderate intensities that maintained open canopies and grassy understory. The grasslands contained some shrubs, low-growing trees and cacti largely confined to drainages that supported little grass and to areas of rocky and shallow soils (Humphrey 1958). After 60 years without livestock, grasses in this category appear to have recovered from grazing.

Common Species: Lechuguilla, prickly-pear, bear-grass, sotol, viguiera, yucca, skeletonleaf golden-eye, ceniza, acacia, *Dalea* spp., grama grasses (Chino, blue, black, hairy and sideoats), tanglehead, lovegrass, California cottontop, green spangletop and threeawns, tobosagrass and alkali sacaton. Shrubs are found on drainages in deeper soils, with grasses, sotols and succulents found more on ridges and shallow soils. Exceptions are tobosagrass and sacaton on deep clay soils in undrained basins.

This vegetation type has the following characteristics:

- Present structure: Grasses are widespread on well-drained igneous soils and now support landscape scale fire (>1000 acres). Without fire, shrubs will increase onto shallow soils on slopes and ridge tops outside what may be their normal range in canyon bottoms.
- Condition class: I -with some shrub encroachment.
- Condition on recent burns: The Gap fire (1992, 2412 acres) at mile marker 4 on highway 118– showed considerable decrease in lechuguilla, recovery of grasses, and increased diversity; Sotol Vista fire (1981, 680 acres) caused by lightning shows recovery of grasses and shrubs, with catclaw and mesquite resprouting slowly; Estufa fire (1994, 3774 acres) near Panther Junction needs to be compared with equivalent unburned area to document fire effects.
- Fire Cause and Frequency: Caused by lightning; fire frequency estimated to be 7-10 years (McPherson 1995)
- Fuel model: 2 (Fire spread is from fine cured herbaceous fuels in addition to litter and downed stemwood. Open shrublands, scrub oak and some juniper-pine assemblages fit this model).
- Insect/disease: None present.
- Problem Invasives: There is only one problem invasive, Lehmann’s lovegrass, in this vegetation type. May or may not be spread by fire but certainly may be a primary contributor to fine fuel loading in the future. Will require specific monitoring following fire events.

Management Directions:

Major goals are to maintain and stimulate plant diversity, allow natural burns within prescriptions, shrink shrub encroachment along the grass-woodland ecotone, and develop natural firebreaks wherever possible.

Grasses have recovered sufficiently from grazing to carry landscape scale fires. Decreased competition during grazing and drought (7 years following park establishment) allowed shrubs to establish in preference to grasses. Several incremental burns may be necessary to remove shrubs where grasses from shallower soils on slopes and ridge tops allowing reestablishment of grasses. Ideally incremental fires will cause shrubs to contract to deeper soils along drainage lines and at the grasslands woodlands ecotone. Monitoring will detect changes in species diversity, fire effects, and use photos to document shrub encroachment.

Shrub Woodland:

This vegetation category contains three cover-mapping categories from Plumb (1993). These are Mixed Scrub, Oak Scrub and Mixed Oak-Shrub Woodlands. This category includes many different shrub

dominated communities scattered in the foothills and mountains of the Chisos Mountains and Dead Horse Mountains. Elevation is from 4,500 ft at Green Gulch to 5,500 ft near the Chisos Basin. Annual precipitation averages 12 to 16 inches.

Common species: Low growth Gray and Emory oak, catclaw acacia, catclaw mimosa, aloysia, slimleaf viquiliana, Evergreen sumac, Shorthorn jefea, and low-growth redberry and alligator junipers.

This vegetation type has the following characteristics:

- Present structure: The occurrence of shrubby thickets may be associated with human disturbance or higher precipitation at increasing elevation. Catclaw and bee shrub thickets are densest where stock camps, stock pens and homesteads were located. Evidence of grazing suggests that fires were also suppressed allowing juniper, pinyon and oak to increase and canopies to close. These woody fuels and thickets are generally not near ridgetops or areas conducive to lightning and have suppressed understory fine fuels, limiting the spread of fire. Fires are most likely to occur when high winds drive a grass fire into these areas.
- Condition class: II
- Condition on recent burns: Blue Creek (1989, 334 acres) human caused, burned the scattered overstory of pinyon and juniper at high-intensity causing high mortality; scrub-oak and shrub regrowth is very thick and grasses have responded strongly.
- Fuel model: 6 (Fire carries through the shrub layer at moderate wind speeds (8mi/hr) but drops to the ground at lower speeds and at breaks in the canopy.)
- Fire Cause and Frequency: Lightning prior to monsoon. Probably frequent surface fires that kept canopies open, maintained grassy understory and limited stand density, 10-30 years? (based on Kaib et al. 1996)
- Insect/disease: Some areas of oaks stripped in 1999 and 2000 by variable oakleaf caterpillar. Mild winters accompanied by drought stress possibly caused death of the trees.
- Problem invasives: Buffelgrass has established at the Chisos Basin, demonstrating adaptation to greater cold than has been recorded. Global warming trends may lead to reestablishment at burn sites during mild winters.

Management directions.

Major goals are to keep natural ignitions within low and moderate intensities; protect federally listed species habitat; restore areas heavily impacted by grazing in Green Gulch and Oak Canyon; and, create a plan for meeting fire moving upslope from high desert grasslands. Fires would thin juniper and pinyon saplings and reduce shrub cover. Results from monitoring would shape future management decisions. Monitoring will capture fire effects, condition of habitat for federally listed species, and coverage of bee brush and prickly pear where livestock camps were concentrated.

Grassy Woodlands

Grassy Woodlands contain three cover-mapping categories from Plumb (1993). These are Pinyon-Juniper-Grass, Pinyon-Oak-Juniper, and Forest-Meadow. These categories are found approximately 5,500 ft to 7,200 ft with more than 16 inches annual rainfall.

Common species: Mexican pinyon, redberry juniper, weeping juniper, alligator juniper, gray oak, Graves and Emory oaks. Understory species of *Salvia* spp., Harvard agave, silk-tassel garrya, bull muhly, pinyon rice-grass.

This vegetation type has the following characteristics:

- Present structure: This category shows canopy closure revealed in an examination of black and white aerial photography between 1962 and 1991 by park staff. How extensive this phenomena is currently under investigation. Fire-scar data suggest more frequent fire in the past prior to the

grazing and suppression era (Moir 1982). General observation of the landscape shows frequent fire-scarred alligator junipers and charred woody debris on the ground. More severe fires would have consumed trees rather than left abundant scarring suggesting fires were grass carried and relatively fast-moving.

- Condition class: II
- Condition on recent burns: Fires larger than 100 acres include the Laguna Meadows (1980, 202 acres) and Casa Grande (1999, 230 acres). All were human caused and facilitated by the recovery of fine fuels at mid to high elevations.
- Fire Cause and Frequency: The present abundance of fine fuels would support landscape scale fires but they have not occurred. Lightning strikes may have been extinguished by rainfall or contained by topography, or part of a more complex cycle involving climate, species and anthropogenic factors. Moir (1982) conservatively estimated a fire return interval of 70 years.
- Fuel model: 2 - primary carrier of fire is now grass. Fire spread is from fine cured herbacious fuels in addition to litter and downed stemwood. Open shrublands, scrub oak and some juniper-pine assemblages fit this model.
- Insect/disease: Caterpillar damage on oaks.
- Problem invasives: None at present. Native bee brush has colonized areas disturbed by grazing.

Management directions:

Major goals are to manage this vegetation assemblage for ecological processes by allowing fires to burn within prescriptions at low and moderate intensities; protect sensitive resources where mandates direct; and, conduct research burns to learn more about fire effects and fire dynamics. Staff species diversity retained and fuels reduced. Monitoring will document fire effects and species diversity, particularly from research burns.

Forest

The Forest category contains two cover-mapping categories from Plumb (1993). These are Pinyon-Talus and Oak-Ponderosa Pine-Cypress. Forest occurs above 6,000 ft with annual precipitation above 16 inches and forms a mosaic of conifers and grassy woodlands with various other species. The abundance of dissimilar taxa was one reason for the UNESCO Biosphere designation in 1976.

Common species: Mexican pinyon, Graves oak, redberry, weeping and alligator junipers.

Distinct populations: Arizona cypress and Douglas fir in Boot Canyon, red oak in Western Chisos; quaking aspen on NW side of Emory Peak; one lateleaf oak and small numbers of netleaf oaks in the high Chisos; Texas madrone on north slopes and canyons, Chisos hophornbeam on slopes north of Emory Peak and Crown Mountain and in Boot Canyon, and also near Pinnacles Trail and upper Cattail Canyon.

Less common species: Ponderosa pine in Boot Canyon, Pine Canyon and Crown Mountain; Bigtooth maple in canyons and north-facing slopes; orchid of all species scattered throughout the Chisos; and Guadalupe fescue on the moist slopes of Boot Canyon.

This vegetation type has the following characteristics:

- Present structure: Fuel loads are high with continuous duff of 6-8 inches in places, 5-10 tones/acre standing dead and downed
- Condition class: II or III
- Condition on recent burns: Fire is expected to burn in this assemblage but it hasn't. Perhaps there has been insufficient grass cover to allow fire to spread, fuel moistures have been too high during lightning strikes, fires have been contained by topography, or the public has engaged in clandestine fire-fighting efforts.
- Fuel model: 10 (considerable litter and 3 tonnes/acre dead and downed; high-severity fire likely burning soil organic matter, soil seed reserves, and canopy; stand conversion possible from forest to oak shrubland)

- Fire Cause and Frequency: Lightning caused in the past. Fire frequency estimates are currently being evaluated by the National Park Service and Yale University
- Insect/disease: Standing dead has some insect and disease damage; some death from variable oakleaf caterpillar. Damage may also have resulted from drought stress.
- Problem invasives: No problems at present.

Management directions:

Management challenges abound in this category. A mosaic of relict, sensitive, and charismatic tree species and other rare species covers the steep foot-accessible Chisos. Any high-severity fire in these fuels would require a heavy-handed suppression to save existing rare, threatened or special plants. Where possible fire would be let burn to natural boundaries such as cliffs or talus slopes, trail or roadway using hand tools only within prescriptions at low and moderate intensities. The challenge is how this is to be done. Research fires to understand fire dynamics will reveal how to safely reduce fuels in forest vegetation. Monitoring efforts will be applied to natural, research and prescribed fire in this category to document species diversity and understand fire effects and dynamics in particular species, habitats, and terrain. Vancat (forthcoming) proposes that high-severity fire has not occurred in the North Rim of the Grand Canyon's mixed conifer forests because of heterogeneous topography. This offers a possible explanation for the lack of fire in the Chisos despite abundant lightning strikes and heavy fuels. Research burns will be associated initially with mesic environments which represent late successional stages in forests and most likely to indicate effects of fire in valued habitats.

(b) Unique Habitats

Six habitats are determined as unique within the park and highly valued by visitors. These are mountain meadows, Chisos grasslands, upland springs, limestone habitat, dunes, and Chisos woodlands and forest. Most of these habitats occur within wilderness, which guides management strategies.

Mountain meadows contain a mix of grasses, forbs, semi succulents, shrubs and small tree species. Meadow assemblages are assumed to be maintained by periodic low-intensity fire, a succession stage following disturbance in forested ecosystems (Patton 1992). Lynn Loomis (Marfa NRCS) suggests that soil composition and depth may also influence succession and species. He noted that the meadows are found in depressions with deep soils (60-80") high in organic matter and mollisol-like, with species not found in nearby landscapes (Personal communication, January 2004). Stopher (1998) however, found oak species encroaching on Laguna Meadow suggesting that over time the meadow may eventually revert to woodland. Nabi (1978) in a successional study of pinyon-juniper found fire a necessary agent in preventing tree encroachment into meadows. A prescribed burn planned for the South Rim will burn some of this meadow and results monitored long-term to better understand succession and management needs. New growth following burning may benefit the Yellow-nosed cotton rat, an edemic species.

Limestone habitat occurs across much of the eastern portion of the park. This soft sedimentary rock laid down when the park was covered by an inland sea during the Triassic Era, is readily permeable to water but has low water holding capacity. Plant communities are strongly shaped by the physical and chemical properties of this soil. Growth on these formations is limited by high ph due to dissolution of the calcium carbonates releasing hydroxide ions making other nutrient cations less available (Bohn et al, 1985). Low annual precipitation (4-12") and high evaporation means low organic matter and water-holding capacities in soil. Adaptations to arid conditions abound. Shrubs like creosote and acacia have spreading and deep roots with waxy or resinous leaves. Succulents store water in stems like lechuguilla and cactus. While creosote and lechuguilla will burn, fire is unlikely in these habitats. The fine understory grasses that carry fire are sparse (10-30 percent of cover) and discontinuous.

Upland springs were the mainstay of the short-lived ranching industry (Gomez, 1991). Saltcedar established in many of these sites as it was readily dispersed, established easily, and was widely promoted

for erosion control and stabilization throughout the U.S. In recent years, staff have been applying herbicide to flushcut stumps to prevent reestablishment. In the event of fire, follow up treatment will prevent reestablishment of saltcedar, exotic bunching grasses, blackberries or other non-natives. Native species in these areas include the more moisture dependent Graves and Emory oaks and weeping and alligator junipers.

Dunes cover several acres near Boquillas Canyon on the eastern side of the park. They formed through the erosive action of wind and represent an uncommon landform in the park. Vegetation is sparse and not expected to burn except where buffelgrass has established. The dunes are possibly at greater risk from trampling, cavorting down the slopes, or vehicles driven off-road. The globally rare *Bigpod bonamia* grows among these dunes.

Grasslands refer to two types; high desert grasslands characterized by well-drained igneous soils and sotel, and low desert grasslands found in depressions found on poorly drained, fine textured clayey soils overlaying carbonate soils. Grasslands on igneous soils of the Chisos appear to have recovered after 60 years rest from grazing. These permeable, well-drained soils support blue, black, hairy and sideoats grama, tangelhead, green sprangletop, lovegrass and muhly on moister northern slopes. These grasslands also support a range of shrubs, semi-succulents, succulents and tree species. Higher elevation and precipitation has aided recovery. Now these grasses will carry fire. Of great interest to park staff are the tobosagrass and sacaton on fine-textured soils in depressions. Although Langford (1952) reported riding through high grasses to Hot Springs (probably through Tornillo Flat), they have not recovered with removal of livestock. Desiccation periods between summer rains combined with continued erosion downslope of plants is thought to limit reestablishment. Staff are planning small research burns to test recovery on flat areas. Brush and contouring will be applied after burning to prevent erosion from these sites. Fire return intervals are expected to be longer in more arid areas where biomass recovery is slower. The US FEIS site suggests 30-250 years.

The Chisos woodlands and forests contain many taxa and habitats within 40 square miles or 2 percent of the park. The eroded remains of magma plugs form cliffs and deep gullies where woodland/forest types overlap in the same habitat, different habitats occur at the same elevation but are separated by aspect, and where relict and rare species occur serendipitously in the midst of common species. Of the estimated 100 endemic species in the Chihuahuan Desert (Brown 1994) more than 10 percent occur in Big Bend National Park, many of these in the Chisos.

(c) Designated Wilderness offers unparalleled scenic and recreation and also constrains management options. The park has 533,900 acres of proposed wilderness and 25,700 of potential wilderness. These areas exclude developments, cultural sites, roads and their surrounding buffers. Congress requires these areas be managed as wilderness whether proposed, potential or legislatively approved. The result is a park relatively undeveloped with vast views, little noise and many opportunities for solitude. Park borders are expanded by other protected landscapes nearby. One mile to the southwest of the park is Big Bend Ranch State Park (300,000 acres). Abutting the northeastern park border is Black Gap Wildlife Management Area (83,000 acres), and to the south Canyon de Santa Elena Preserve (208,381 hectares) and Maderas del Carmen Preserve (277,209 hectares). Together these protected areas create more than a 1.67 million acres of wilderness – a unique bioregion crossing two countries and many habitats within the Chihuahuan Desert.

The area offers outstanding opportunities for primitive and unconfined types of recreation. A wilderness designation also means that fire suppression activities will be conducted without bulldozers, planes for retardant drops or chainsaws to remove trees or shrubs- less efficient control methods but less invasive on the landscape. Minimal impact techniques are intended to maintain areas that appear to have been primarily affected by the forces of nature and not by humans. The Incident Commander or the Superintendent can override suppression tactics in wilderness for safety reasons.

(d) Exotic plants Fire may aid invasion of exotic species but may also prove to be a control tool. Approximately 50 exotic plant species are found in the park (Sirotnak 1998). Seven were determined a threat by the IDT to native species in the park because of their ability to replace native species and alter plant community structure and ecosystem function. These seven species are saltcedar, buffelgrass, Bermuda grass, Johnson grass, Lehmanns lovegrass, Russian thistle and giantreed.

Nonnatives or exotics are those species, which did not originally occur in the ecosystem but are currently present because of disturbances. Seeds and/or vegetative parts traveling by wind, water, vehicles, attached to animals and human sox, get established at sites disturbed by fire, flood, drought, disease, changing light, moisture, changed nutrient conditions and physical disturbance. Their success depends on their ability to exploit resources more effectively than native species. Exotics are especially noticeable along roadsides, arroyos, the Rio Grande, and around human habitations. Saltcedar, giantreed, Bermudagrass, Johnson grass and buffelgrass tend to form dense monotypic stands that reduce plant diversity and are less valuable to wildlife than native species. Lehmanns lovegrass is also adapted to fire and spreading into nearby native desert grasses. Russian thistle morphology facilitates the spread of fire.

Saltcedar: Introduced to the US from Asia as an ornamental in 1823, three invasive species have now naturalized many floodplains, streambanks, river courses, marshes and irrigation canals with shallow water tables and minimal erosion in the southwest. Pure dense stands characterize the Rio Grande corridor along sections of the park boundary. It creates litter and ladder fuels and survives fire by prolific seed set, resprouting roots, and layering of buried stems (Carpenter 1999). Seed and flower production following fire is greatly increased (USFS FEIS data base). Saltcedar appears a colonizing species that tolerates burning about every 15-20 years. Herbicide application to freshly cut stumps kills saltcedar and replacement with other species is essential to prevent reestablishment. Widespread infestations may alter wildlife habitat and use, and affect local water uptake and drainage patterns (Lair and Wynn 2002). The 118 miles of riparian corridor is unlikely to be restored in the near future because of insufficient resources and upstream diversions and activities. Several pilot projects in 2006 however, will remove saltcedar along the river corridor and establish native plant species. Saltcedar has been progressively removed from most springs and seeps in the park.

Bermuda grass: A summer growing deep-rooted perennial from Africa introduced to Southwestern pastures to boost livestock production. Survives fire primarily from regrowth of underground rhizomes and from prolific seed production. Can be controlled by deep shade, long-term drought during the growing seasons, and extended freezing temperatures. Firmly established along the river and near human developments across the park. Additional fuels increase flammability and likelihood of fire in an area used often by the public. Control is best achieved with herbicide application.

Buffelgrass: Another species from Asia and Africa introduced to boost range production for livestock. Dense clumps crowd out native grasses and provide abundant dry fuel for carrying fire. Plants resprout vigorously following fire and are prolific seeders. Frequent fire favors this species and could cause the decline of species less tolerant of fire such as cactus and other natives (Tu 2002). A recent survey revealed that buffelgrass has moved from along the river corridor into drier arroyos (Guertin and Halvorson 2004). The park is focusing removal efforts around endangered species.

Lehmanns lovegrass: Imported from Africa for increasing pasture production, Lehmanns lovegrass colonizes disturbed and undisturbed sites successfully (Anable et al. 1992). Staff suspect this grass was part of the seedmix used to stabilize highway 385 roadsides during an upgrade about 35 years ago. Since then it has steadily invaded grasslands adjoining the road. Mowing of the roadsides before seedset helps reduce invasion into nearby grasslands.

Russian thistle: Russian thistle occurs along roadsides and other disturbed areas germinating with summer rains from seed. It becomes stiff and rounded at maturity breaking off in high winds to ‘tumble’ along - an ideal carrier of fire. Mowing of roadsides at strategic times limits populations and seed set. Intolerant of competition, Russian thistle can be reduced by establishing desirable plant species. Manual and mechanical treatment is effective.

Johnson grass: Originally from the Mediterranean, Johnson grass is a widespread perennial forming almost pure stands in richer soils such as depressions formed by road drainages. Frost topkills the plant but it spreads readily from rhizomes and seed when moisture is available and is difficult to eradicate sending rhizomes as deep as 120 cm (Newman 1993). Staff believe the plant is relatively isolated at the park in roadside depressions but cycles of wet years (2003-2004) allows new sites to be established as seeds are carried in runoff. Fires would burn hotter and may damage less fire tolerant native species.

Giantreed: Giantreed has colonized the shallow slow moving river edges. The reed produces masses of rhizomes and stems, which can create ladder fuels into tree canopies. The vigor and denseness of growth excludes native reed and offers fewer opportunities for wildlife. This cane burns rapidly and hotly even when green, spreading to other nearby vegetation (Bell 1993). Park staff burned some giantreed in 2003 and intend to followup on a 5-year cycle in some areas to improve native species habitat.

Exotics increase after wet years and after repeated fires suggesting that methods other than fire be the major control of fire-adapted nonnatives (Brooks and Pyke, 2000). The park has a multi-pronged approach to address nonnative plants in the park including control of further infestations, removal and restoration with native plants, and systematic study to learn about life histories, rates of spread and control measures. A 1998 roadside study classified weeds according to their (1) ability to become a problem, (2) relative ease of control, and (3) current impacts on native plant communities in the park (Sirotnak, 1998). The park calls upon the services of The expert NPS Exotic Plant Management Team (EPMT) based at Carlsbad Caverns NP to help with removal primarily of saltcedar at selected sites. The volunteer “Buffel Bashers” also assist with management of exotics at the park. The size of the park, time to familiarize and train staff, has resulted in roughly two weeks of effective work by the EPMT team each year and exotic bunching grasses are spreading increasing flammability of native plants (Joe Sirotnak, personal communication, 2004). Exotics will be manually removed from around legally protected species wherever possible to reduce risk of fire injury. Appropriate control measures will be used to control exotics if needed after prescribed and natural fires.

Impact Topic (5): Threatened and endangered species

Great biological diversity within the region has arisen as plants and animals have adapted to extremes of temperature and rainfall, mountains and river plains, and differing properties of limestone and igneous soils. The park contains a number of sensitive species. A number of these species have been recognized for their rarity and are granted protection under the Endangered Species Act. This sample however, hardly represents the wealth of wildlife throughout the park, which includes the southernmost extremes of some species such as Black-capped vireo in the United States and the northernmost extremes for some Mexican species such as Colima warbler. A general overview of wildlife species is presented followed by tables of those species considered for effects under the fire program. The same format is followed for plant species.

Wildlife

The Chisos provides a small refuge for state-Threatened black bear and the charismatic mountain lion, just two of 70-75 mammals that use the park. The viability of bear populations relies on travel routes to Mexican mountain habitats, which repopulated the Chisos following their extirpation prior to park

establishment in the mid-20th century. Since recolonization of the park in the late 1980's, the bear population has fluctuated from a high of at least 30 individuals in 2000 to as few as 6-10 in 2001, following severe drought-induced food shortages. (Raymond Skiles, personal communication, August 2004). Mule deer are commonly seen, particularly in high desert grasslands while Sierra del Carmen whitetailed deer are usually found at higher elevations. Bighorn sheep, once established in the river canyons and arid mountain regions, were extirpated by hunting and disease transmitted from domestic livestock.. Black Gap Wildlife Management Area on the park's northeast border has reintroduced them, which staff hope will lead to recolonization of the park. Smaller mammals such as skunks, rabbits and rodents complement the mountain lion's main diet of deer and javalina. Gray fox, Black-tailed jackrabbits and coyotes may be seen along riparian areas or in desert scrub, particularly at dawn or dusk when heat and aridity are less harsh. The endangered Mexican long-nosed bat, and the Western pipistrelle can be seen against an evening sky particularly around the mountains.

Sheltering mountain ranges and assured water provide routes for birds migrating between countries and hemispheres. The location and diversity of habitats gives rise to more species per unit area (6.3) than the Guadalupe (1.2), Davis Mountains (1.01) or Madreas del Carmen (0.63) (Wauver and Ligon 1977; Wauver and Riskind 1974). There are an estimated 450 species that have been observed in the park with approximately 100 species nesting each spring. Mesquite along the river provide habitat for Yellow-billed cuckoos. Black phoebe is common and the yellow-breasted chat can also be seen along the riparian corridor. A lucky visitor to the Rio Grande may see Common black hawks and Gray hawks nesting or beaver feeding along the bank. In the drier desert habitat, cactus wrens dart after insects and reptiles, curve-billed thrashers hunt insects, roadrunners are not uncommon and turkey vultures hover over the landscape watching for carrion . Loggerhead shrikes skewer bugs on thorns in high desert grasslands where mockingbirds and the brilliantly colored orange and black Scotts Oriole is also found. Higher elevations of oak, juniper and pinyon pine woodland, with grassy and shrubby understory are more mesic and support broad-tailed hummingbirds, bushtits, gnatcatchers, gray-breasted jay and screech owls. These oaks and conifers also provide for the acorn woodpecker, Northern flicker, Colima warbler and Rufous towhee. Elf owls are found along a broad elevational range and can be seen nesting in telephone poles in desert scrub, and in cottonwoods at springs and along the Rio Grande.

One of the goals of the proposed research program is to understand the role of fire in the restoration of lowland desert grasslands. Greater areas of tobosagrass may attract Northern Aplomado falcons now established 100 miles northwest of the park at Marfa, and create more reliable habitat for Peregrine falcons, and other raptors.

The Texas horned lizard is one of 56 reptile species in the park, and is on the State of Texas list of threatened species. Its home is sparse vegetation in desert scrub, making reliable population estimates difficult. It is unlikely to be affected by more burning as its habitat lacks fine understory fuels to carry fire. More commonly seen species in desert scrub or grasslands are the coachwhip and Trans-Pecos rat snake . Diamondback and black-tailed rattlesnakes are occasionally seen. Only after summer rains fill ephemeral ponds do Couch's spadefoots and green toads surface in abundance.

Probably most at risk are the aquatic species (including 29 remaining native fish species) due to Rio Grande diversion, alteration of flow cycles, contamination and exotic species invasion.. Six native fish species no longer exist in the Big Bend region, including the endangered Rio Grande silvery minnow; seven of the remaining fish species are species of concern. Only dead shells of mussels have been found in recent years; the Texas hornshell is a species of concern. These impacts are not easily addressed as the legal and political authority for river use and management decisions lie outside the park's jurisdiction.

Staff identified 11 protected species likely to be affected under the fire program in Table III-1. The management trajectory and safeguards under the preferred alternative suggested that only two federally listed species may be impacted by the FMP. These are the Mexican long-nosed bat and the black-capped

vireo. The park has written a Biological Assessment (BA) that describes plans for limiting impacts to these species for U.S. Fish and Wildlife Service review. Measures to protect these species and their habitat include: prescribed burns to reduce fuels and protect habitat from high-severity fire; research burns to understand fire dynamics and desired fire intensities; multiple measures to avoid or minimize direct damage; and, mitigative measures should damage occur. Staff will review the fire program annually to incorporate monitoring information, fine-tune prescriptions and incorporate lessons learned into fire operations. A database of fire effects on habitats through will be created from monitoring of prescribed and natural burns when resources permit. Resource managers have focused research efforts on better understanding life histories of selected species such as the black bear, and targeting the effects of fire on the habitat of endangered species to support these populations. Research efforts are generally partnerships between staff with local knowledge and expertise and scientists from academic institutions.

Wildlife

Gambusia gaigei -Big Bend gambusia

USFWS –Endangered ; TPWD – Endangered/threatened

Warm springs near Rio Grande Village supply freshwater to three ponds containing Big Bend gambusia. The fish are estimated to have survived since the Pleistocene, having adapted to specific and consistent warm-water conditions. Several cautions have been expressed in relation to prescribed burns in the area. These are the loss of shade, runoff-borne ash and sediment from burns upslope, changing pH as a result of ash, and fuels or other contaminants resulting from suppression activities.. Placement of logs and branches to provide shade, foraging and hiding habitat will be used if needed after future burns. A recent prescribed burn deposited significant ash in one of the ponds, yet post-burn mosquitofish monitoring revealed no apparent mortality. Paying attention to vehicle placement and rerouting any spills away from the ponds will mitigate risks from fuel or chemical spills.. A boardwalk made of recycled materials could pose a toxic threat if burned. Prevention of high-density and high-risk fuel buildup through appropriate prescribed burning is intended to reduce risks associated with intense fire around mosquitofish habitat. ent burning. An equally significant risk to gambusia is humans introducing exotic species, such as bait or aquarium fish into the ponds (Clark Hubbs, Cary Coventry and Raymond Skiles, personal communication April – June, 2003).

Leptonycteris nivalis -Mexican long-nosed bat

USFWS-endangered; TPWD – endangered

This migratory bat ranges from southern Mexico into Texas and New Mexico. There is one major roosting site in the park where young are reared. Annual visitation by bats varies seasonally, perhaps in response to varying availability of their food source, nectar of century-plant agaves. The main threats to the bat are destruction of roosting sites and foraging habitat. Wildland fire may at least temporarily reduce agave populations in burned areas. Proposed mitigation measures include maintaining 80% or more of agave habitat all times. Mature agaves can survive low intensity fire (Powell 1996; Johnson 2001). The well-ventilated roosting site could draw smoke and heat into the cave if fire came close to the entrance and will be protected by managing fuels downslope of the protective shield of vegetation covering the opening.

Vireo atricapilla- Black-capped vireo

USFWS-endangered; TPWD-endangered

Twenty three of these insectivorous songbirds were observed in the park in 2004 (Maresh 2004). Vireos are found from Oklahoma to Coahuila in Mexico. For nesting habitat, they require 6' shrubs with foliage extending to ground level. Shrub species appears less important than the presence of a mix of broad-leaved shrubs, foliage to ground level and a mixture of open grassland and woody cover, usually containing junipers. Shrubs occupying 30-60% or more of the total cover seem preferred (USFWS 1995). The courtship and nesting period last from mid March through mid-September. Vireos are vulnerable to

changes in habitat, particularly through plant succession, and nest parasitism from Brown-headed Cowbirds.

Sensitive Species

The most apparent are black bear, mountain lion, Desert Bighorn sheep. Desert Bighorns were reintroduced into Black Gap Wildlife Management Area to the northeast of the park in 2000, and some have migrated into the park. Desert Bighorn are also being re-established south of the park. It is hoped these initiatives will result in their restoration in historic park habitat. Desert bighorn favor sparsely vegetated areas without visual obstruction. Fire may play a role in maintaining or restoring this habitat. The Colima warbler is at its most northerly range in Big Bend and avid birders travel the country to find it. Mountain lion are mobile and follow prey and are not legally protected outside the park. The small black bear population is sensitive to fluctuating food supplies, and even temporary and local habitat changes during drought periods may have negative results. Of particular concern is loss of reproducing females, of which there were only two known in 2004. A significant risk is management removal of bears, particularly females, due to bear/human conflict that could result from improper food or garbage management by park visitors or residents. Small burns that maintain mosaics of bear habitat are best for maintenance of bear food sources.

Coccyzus americanus- Yellow-billed Cuckoo

USFWS- Candidate

The Yellow-billed cuckoo has been seen feeding on caterpillars in cottonwood and mesquite groves near Rio Grande Village (Mark Flippo, park biologist at Big Bend, personal communication January, 2004). It is unknown whether stands of salt cedar offer the same food resources for the birds. Any fire in the river corridor that burns salt cedar or exotic vegetation will be followed up with herbicide treatment to prevent re-growth of exotic plant species. The fire program as a component of native riparian tree restoration is likely to benefit the cuckoo.

Eumops perotis californicus -Greater Western Mastiff Bat

USFWS- SOC

The Greater Western mastiff bat roosts in crevices in canyon walls and flies the river corridor, seeking insects attracted to riparian vegetation. Unless fire occurs directly under a roosting crevice the bat, being mobile, is unlikely to be negatively impacted by the fire program.

Falco peregrinus anatum -American Peregrine Falcon

USFWS- Delisted

The Peregrine falcon nests on cliff ledges in the park and under delisting criteria will be monitored every three years for 15 years. In the event of fire, falcon eyries will be designated sensitive areas and a buffer of ½ mile established vertically and horizontally from each site. Fire management operations will avoid these sites during nesting season from February 15 to July 15.

Phrynosoma cornatum -Texas Horned Lizard

USFWS- SOC, TPWD - Threatened

This lizard occupies the open ground of desert scrub, making estimating its numbers a challenge. Natural ignitions in desert scrub are unlikely to impact the lizard as limited and discontinuous fuels only support patchy fire under high winds.

Popenaias popei -Texas Hornshell

USFWS- Candidate

Texas Hornshell is a mussel that is still believed to inhabit the Rio Grande in small numbers. Recent surveys have revealed only dead shells, but no living specimens. Altered flow, increasing salinity and

contaminants are thought to be reducing numbers. The proposed alternative is not expected to have any additional adverse impact on this species.

Ursus americanus mexicanus -Black bear

TWPD – threatened; Mexico- endangered

Following extirpation from the Big Bend region, it took 50 years for black bears to recolonize the Chisos Mountains. A small number of bears, including at least one female, migrated from the Sierra del Carmen of adjacent Mexico in the mid-1980's. Frequency of bear sightings increased from 1988 through 2000, when at least 30 individuals were known to inhabit the park, including five breeding females (Onorato, 2003). Drought-induced mast (soft and hard nuts and berries) failure is thought to have resulted in a severe population reduction. In 2004, only two breeding females were known among the 8 – 15 bears thought to inhabit the park in 2004 (Raymond Skiles, personal communication, 2004). They need forest and woodland habitat to supply the high-mass, high-calorie foods for fall hibernation. Research is needed to develop an ongoing bear population and bear food monitoring program. Such a program would inform fire strategy development. In the absence of such information, the best fire policy appears to burn small areas while maintaining mosaics of intact vegetation, and monitor pre and post-fire vegetation.

Apodemia chisosensis -Chisos Metalmark

TNC G1 Critically imperiled because of extreme rarity

Chisos metalmark is an endemic butterfly and possibly derived from the Nais Metalmark found to the west of the park. The host is *Prunus harvardii*, a shrub to six feet and found mostly in the Chisos scattered along drainages, high desert grassy woodlands and ridge tops. The butterfly is reported most commonly in Green Gulch, which is readily accessible from a near-by road but other populations may be present. Fire could destroy habitat along drainages but rejuvenate grassland habitat.

Table III-1: Special Status Wildlife Species Associated with Big Bend National Park

Common Name	Scientific Name	Status	Habitat Type
<i>Species whose entire population might be affected by a high-intensity fire</i>			
Black bear	<i>Ursus americanus mexicanus</i>	State T	Forest and woodland habitat with many shrubs to supply high mass, high calorie food. Seasonal use of diverse desert arroyo food sources. Large high-intensity fires could cause bears nutritional stress, and result in them migrating out of the park. Small, prescribed fires outside breeding and peak feeding times would cause least disruption.
<i>Species whose local populations may be affected by a high-intensity fire</i>			
Greater western mastiff bat	<i>Eumops perotis californicus</i>	Federal SOC	Common in river canyons, which are not likely to burn. Feed on insects populations along the river but can forage beyond burned areas.
Mexican gray wolf	<i>Canis lupus baileyi</i>	Federal E, Ex, State E, Ex	Experimental populations are being established in southeast Arizona from 1998. Wolves travel 30 miles to hunt, and may travel 500 miles to find new territory, possibly finding their way into the park. Prescribed or wildland fires are unlikely to pose problems unless females have young.
Mexican long-nosed bat	<i>Leptonycteris nivalis</i>	Federal E, State E	The bat feeds on agave blossom nectar from 3500-7800' primarily in oak-juniper woodlands. Fires are ideally small to limit damage to agaves and roosting sites or patchy to preserve areas of agaves.
Black-capped vireo	<i>Vireo atricapilla</i>	Federal E, State E	Requires shrub woodland with large 6' shrubs to the ground. Fire would adversely impact currently inhabited areas. Prescribed fire useful for research burns to improve habitat.
Peregrine falcon	<i>Falco peregrinus</i>	Federal DC, State E	Nests on cliff ledges from mid February to mid August. Suppression activities including overhead flights would be highly disruptive.
Northern Aplomado falcon	<i>Falco femoralis septentrionalis</i>	Federal E State E	Not currently in the park but established near Marfa, 100 miles NW. Fire in grassland would increase prey post-fire and lead to more prey long-term. Nests on trees and other shelters in grasslands
Yellow-billed cuckoo	<i>Coccyzus americanus</i>	Federal C	Nest primarily in mature cottonwood from March through September. Forage in mesquite thickets for fuzzy caterpillars.

			Fires need to be small and low intensity, to protect roosting and foraging sites.
<i>Species likely to be adapted to fire or unaffected by high-intensity fire</i>			
Big Bend gambusia	<i>Gambusia gaigei</i>	Federal E, State E	Clear, shallow warm spring-fed natural pools and marshes. Fires may reduce cover, feeding and overstory shading habitat . Avoid removing all habitat around ponds; avoid burning synthetic material in boardwalk over habitt.
Texas horned lizard	<i>Phrynosoma cornutum</i>	Federal SOC, State T	Common in open habitat of desert scrub with little flammable material. Full distribution unknown.
Texas hornshell	<i>Popenaias popei</i>	Federal SOC	Studies by NPS, contractor, and Texas Parks and Wildlife in have revealed only dead shells, no live specimens. Dams, water release patterns, low flows due to agricultural use, and resultant increases in salinity have adversely impacted Texas hornshell. Fire used in conjunction with control of salt cedar may increase surface flows and improve water quality.

Status:

SOC = Species of Concern

E = Endangered

T = Threatened

DC = Under Delisting Criteria

Ex = Extirpated

Sources:

Texas Parks and Wildlife Division update from Austin office July 2004.

Plants

Vegetation of Big Bend was introduced under impact topic 4. The park is extraordinarily diverse with 1200 plant species, approximately 120-130 of these rare or endemic to the park. Staff identified 33 federally listed species for consideration under the fire program in Table III-2. Federally listed plant species in the park include Bunched Cory cactus (*Coryphantha ramillosa*), Chisos Mountain hedgehog cactus (*Echinocereus chisoensis* var. *chisoensis*), Lloyd's Mariposa cactus (*Sclerocactus mariposensis*), and Hinckley's oak (*Quercus hinckleyi*). Guadalupe fescue (*Festuca ligulata*) is a candidate species. Only the Chisos Mountain hedgehog cactus is likely to be adversely affected by the activities under consideration for the new FMP and is being formerly assessed under a U.S. Fish and Wildlife Service Biological Assessment concurrently with this EA. There are 12 species whose habitat consists of rocky ledges and sparsely vegetated areas and unlikely to be affected by fire; 14 species are considered tolerant of fire; local populations of 2 species could be affected by high-severity fire; and 5 species are very rare and high-severity fire could kill the entire population. The candidate species Guadalupe fescue is measured under a conservation agreement with the U.S. FWS dating from 1998.

Staff are concerned and interested in the many rare plants- at least 120 species. So little is known about the lifecycle, location, and number of many of these plants that they cannot yet be included in a federal listings program. To remedy this situation, staff are continually updating GIS databases with new locations and are gradually gathering information about the life cycle of these plants, recognizing that the public rely upon the park for their long-term conservation.

Fire has occur here (Moir 1982) and will occur in the future. Its intermittent occurrence may be a reason for the current plant diversity. Presumably, plants experienced some level of fire in the past but possibly not the high-severity fire possible under current fuel loads. Staff have created the safeguards below to lessen possible adverse effects from fire. These are:

- Evaluate fire effects and fire dynamics of selected species and habitats using research burns, the results guiding introduction of prescribed and natural fire in the Chisos.
- Allow natural ignitions within prescriptions (low and moderate intensities) to reduce fuels. Low intensity fire lessens damage to plants and is thought to mimic pre-European fire.
- Monitor all prescribed fire (and natural fire if possible) to fine-tune prescriptions allowing modifications to enhance the protection of plant species if needed.
- Suppress all fires burning outside prescriptions.
- Select locations of staging sites, natural firebreaks and spike camps prior to fires to avoid unnecessary ground disturbance from containment and suppression activities. These locations have been selected under the emergency evacuation
- Continue adding location and life history data of rare, threatened and endangered plants to a GIS database.

Special species and expected fire effects

Castilleja elongata- Tall-Stemmed Paintbrush

USFWS – candidate

Highly visible reddish bracts emerge with summer monsoons. Found in open woodlands, grasslands, and along trailsides at moderately-high elevations with Coahuila scrub oak, pinyon ricegrass, pinyon pine, mountain mahogany, and with alligator juniper at high elevations. Found in fire tolerant habitats and expected to survive low intensity burns outside the growing season. The plant is browsed by deer, in danger of being overcrowded by shrubs, soil erosion and from trampling in heavy use areas. Reduction of woody vegetation with prescribed burns may benefit this species.

Coryphantha ramillosa – Bunched Cory Cactus

USFWS - threatened

Large pink to purple flowers have attracted cactus poachers. Found on limestone foothills ledges and crevices of limestone with lechuguilla, candelilla, leatherstem, yucca, ocotillo, prickly pear, and dog cholla. Restricted to the Boquillas Formation and Santa Elena Limestone (2500-3500 ft) in the park but also occurs in SW Terrell and Coahuila, Mexico. Rock crevices provide refuge from low intensity fires.

Echinocereus chisoensis var. *chisoensis* - Chisos Mountain Hedgehog Cactus

USFWS threatened

A cactus endemic to the park and found on alluvial flats of well-developed desert pavement with creosote, lechuguilla, ocotillo, leatherstem, sea urchin cactus, and dog cholla. Often present under or within a nurse plant at elevations of 2250 ft. Dark green stem and white cottony material present when flowering attracts cactus poachers. Expected to fire except where buffelgrass has invaded habitat.

Festuca ligulata – Guadalupe fescue

USFWS – candidate

Rare perennial grass from 14-30 inches occurring at 6000 ft on gentle, forested slopes in canyon bottoms with oak and pine overstory. Managed under a conservation agreement with the USFWS since 1998. Moir (1996) estimates that 155 years have passed since a low-intensity fire burned through this area. Most grasses are fire adapted resprouting from the base following fire. Current low seedling establishment may be due to high duff levels preventing seed contacting mineral soil. Very small research burns are proposed to examine seedling recruitment in mineral soils.

Sclerocactus (Neolloydia) mariposensis- Lloyd's Mariposa Cactus

USFWS threatened

Found on arid, gravelly, limestone-derived soils on gentle slopes, primarily on the Boquillas Formation in sotol-lechuguilla shrublands at elevations of 2,500-3,500 feet. Cactus poachers have decimated populations outside the park but populations are quite numerous in some areas (Anderson and Schmalzel 1997). Fire occurs in these formations but low fine fuel loading result in localized and low intensity fires.

Plants listed as threatened or endangered in Texas

Agave glomerulifolia – Chisos Agave

Species of Concern

An agave with flowers raceme on a 5-6 m stalk. Found in grasslands of the Chisos Mountains with pinyon pine, juniper, and bull muhley. Fire tolerance depends on fire intensity and size of plant, with larger plants more tolerant than younger plants. Chisos agave is also at risk of being inadvertently destroyed by maintenance activities along trails and roads. Mature Palmer's agave was found to better withstand fire than juveniles and seedlings or young offshoots (Howell 1996; Johnson 2001).

Andrachne arida – Trans-Pecos Maidenbush

Species of Concern

Rare shrubs less than one meter found on limestone slopes, canyons and crevices mostly in the Dead Horse Mountains, NW of Solitario Peak in Black Gap and in Coahuila, Mexico. Distinguished by greyish-white leafy twigs. Occurs in dry conditions little available fuel to carry fire. Not expected to be affected by the fire program.

Aquilegia longissima – Long-Spur Columbine

Species of Concern

Up to a meter tall with conspicuous yellow flowers. Found in moist canyons among boulders on ledges and sheltered crevices in canyons with species of oak, bigtooth maple, Mexican buckeye, drooping juniper, and evergreen sumac. A mesic species that is unlikely to tolerate fire. Seed stored in soil may

facilitate post-fire recovery. Low to moderate intensity fires in normal fuel loads creating mosaics of burned and unburned vegetation is unlikely to adversely affect populations.

Batesimalva violacea – Purple Gay Mallow

Species of Concern

Slender erect shrub to 2m with blue-purple flowers. Found among boulders and rubble in moist canyons with species of oak, Texas persimmon, Mexican buckeye, evergreen sumac, and fragrant ash. Expected to be fire tolerant as conspecific vegetation is fire tolerant.

Bonamia ovalifolia – Bigpod Bonamia

Species of Concern

Flowers on this low forb are blue-purple and bell-shaped. Found in sand and among boulders, and also found in sandy drainages along roadside. Subject to trampling by humans on dunes and its habitat invaded by buffelgrass. Buffelgrass would increase the flammability and heat of any fire with unknown effects on the Bigpod. There are plans to remove buffelgrass from around known populations.

Brongniartia minutifolia – Littleleaf Brongiart.

Species of Concern

Endemic to the park and found in arroyos, blackish sandy soil and perhaps limestone. An attractive shrub about one meter high with small leaflets and yellow-green flowers. Fire effects unknown.

Chamaesyce golondrina – Swallow Spurge

Species of Concern

A prostrate, hairy annual herb with non-showy flowers found on alluvial desert soils. Fire effects unknown but found in areas with discontinuous fuels.

Chamaesyce chaetocalyx var. *trilulata* – Three-Tongued Spurge

Species of Concern

Endemic, perennial to 15 cm only found in crevices of limestone cliffs above entrance to Boquillas Canyon from 3000-3500 ft in elevation. Occurs where it is unlikely to be at risk from fire.

Coryphantha chaffeyi – Chaffey's Cory Cactus

TPWD –Threatened

White flowered cactus found on rocky igneous or limestone areas in open areas or under trees. In the Chisos Mts. from (5800-7000 ft). Inadvertantly destroyed by hikers, trail maintenance, and some poaching. Limited fuels means this cactus is likely to escape fire effects in open areas.

Coryphantha dasyacantha – Dense Cory Cactus.

Species of Concern

Found on rocky/gravelly igneous soil of desert scrublands; may also occur in limestone derived soils in woodland and grassland into the desert from 3400-3800 ft. Pink flowers. May also occur in Mexico. Limited fuels mean that fire effects are likely to be localized.

Coryphantha duncanii – Duncan's Cory Cactus

Species of Concern

This pink flowering cactus is found in crevices of limestone shelves at elevations between 2100-2625 ft in the park and slightly higher in New Mexico. Threatened in NM from habitat disturbance. Occurs in sparsely vegetated habitat within Big Bend suggesting that the cactus is likely to escape fire in the park.

Coryphantha albicolumnaria –White Column Cactus

Species of Concern

Conspicuous radial spines that whiten with age and rose-pink to magenta flowers. Found on broken limestone and on rocky alluvium with creosote, lechuguilla, candelilla, dog cholla, skeletonleaf goldeneye, leatherstem, false agave, and resurrection fern at elevations between 1900 and 4800 ft dispersed over Texas and New Mexico. Subject to poaching and damage from mine closure activities. Amount of understory fuels, shrub cover, and wind speed would determine likelihood of fire damage.

Hexalectris nitia – Glass Mountain Coral Root

Species of Concern

Small shiny purple flowers that bloom one at a time. Found among rocks in shaded canyons with abundant pinyon-oak-juniper leaf litter. Occurs in areas with oaks, which resprout after burning so may withstand or regrow from roots following fire.

Hexalectris revoluta – Chisos Coral Root

Species of Concern

Perennial from 30-40 cm high found in moist or dry oak woodlands in mountains at 4,500-5,200 ft. Grows under edge of oak trees in canyon bottoms and on slopes between boulders. Blooms June through July. Boulders would provide some shielding from fire; plants in drainage bottoms likely to be consumed by fire but may resprout from roots as they occur with oaks tolerant of fire.

Hexalectris warnockii –Texas Purple Spike

Species of Concern

Smooth maroon stem with large nodding showy flowers veined with purple, adorned with orange-yellow lamellae and purple at the apex. Found in shady juniper-oak woodlands above 5900 ft. Occurs in areas which probably experienced fire in the past; fire tolerance unknown.

Lechea mensalis – Chisos Pinweed

Species of Concern

Inconspicuous, tall, straight perennial herb found in pinyon-juniper country and the wooded summit of Mt. Emory in 1992 and on ridge exposures of Ward Mountain (1966). Fire effects unknown but occurs in areas that have experienced fire in the past.

Opuntia aureispina- Golden-Spined Prickly Pear

Species of Concern

Found on limestone hills near the Rio Grande from Mariscal Mountain to Boquillas Canyon. Distinguished by yellow spines and yellow flowers with red centers and dry, tan spiny fruits. Occurs in areas with little vegetation but buffelgrass is invading and would increase fire intensity. Pads surviving fire reestablish.

Opuntia imbricata var. *argentea* – Silver-Spine Cholla

Species of Concern

Distinguished from tree cholla by silvery spines. Found on gravelly and sandy soils in the park with little understory. May be damaged in high wind driven fire or where buffelgrass has established underneath.

Ostrya chisoensis – (*Ostrya virginiana* var. *chisoensis*). Big Bend Hophornbeam.

Small trees to 12 meters found 5,000-8,000 feet in canyons and slopes north of Emery Peak; Crown Mt; and Boot Springs. Fire tolerance unknown but occurs in areas where fire has occurred.

Quercus tardifolia –Chisos Mountain Oak

Species of Concern

Short, dense trees with thick bark in woodlands at 7,000 ft along arroyos in the Chisos and canyon bottoms in shaded, igneous soil. Found between Boot Spring and South Rim and Upper Boot Canyon. Fire tolerance unknown but most oaks resprout from roots or under bark following low-intensity fire.

Quercus graciliformis – Chisos or Slender Oak

Species of Concern

Endemic small evergreen trees to 8 m or more with graceful, arching, slender branches. Usually found in rocky canyons with high water tables such as Juniper Spring and Blue Creek Canyon. Fire tolerance unknown but most oaks resprout from roots or buds under bark following fire. Likely to survive low intensity fire.

Stenaria mullerae var. *pooleana* – Houstonia pooleana

Species of Concern

Perennial 3-4 cm x 5-10 cm wide found on vertical limestone cliff faces in the Dead Horse Mountains. Associated plants include agave, lechuguilla, oaks and rhus spp. Collected in 1987 at 4840 ft. Probably experienced infrequent low intensity fire. Might be consumed by high intensity fire with long-flame lengths if sufficient vegetation established below cliffs.

Streptanthus cutleri – no common name

Species of Concern

This annual is a member of the mustard family growing from a vertical taproot to 20-70 cm. It is found where there is little competition on talus slopes, gravelly dry streambeds, limestone slopes, rocky hillsides and sand flats. Flowers March through April with a dark purple flower followed by 4-7 cm long fruits. Occurs where there are few fine fuels to carry fire

Table III-2: Sensitive Plant Species under all Alternatives

Common Name	Scientific Name	Status	Habitat
<i>Species occurring on rocky ledges or in other areas relatively protected from fire:</i>			
Bunched cory cactus	<i>Coryphantha ramillosa</i>	T-F	Limestone crevices and ledges on low hills associated with the Rio Grande corridor
Chisos Mountain hedgehog cactus	<i>Echinocereus chisoensis</i> var. <i>chisoensis</i>	T-F	Alluvial flats of desert pavement in southeast portion of the park
Cutler's twistflower	<i>Streptanthus cutleri</i>	SOC-F	On talus slopes, gravelly dry streambeds, limestone slopes, rocky hillsides and sand flats
Duncan's cory cactus	<i>Coryphantha duncanii</i>	SOC-F	In crevices on limestone shelves
Golden-Spined prickly pear	<i>Opuntia aureispina</i>	SOC-F	On limestone hills
Lloyd's Mariposa cactus	<i>Sclerocactus mariposensis</i>	T-F	Gravelly limestone derived soils
Silver-Spined cholla	<i>Opuntia imbricata</i> var. <i>argentea</i>	SOC-F	Gravelly and sandy soils mostly in desert scrublands
Swallow spurge	<i>Chamaesyce golondrina</i>	SOC-F	Alluvial desert soils
White column cactus	<i>Escobaria albicolumnaria</i>	SOC-F	Broken limestone and rocky alluvium.
Trans-Pecos maidenbush	<i>Andrachne arida</i>	SOC-F	Limestone slopes, canyons and crevices
Three-Tongued spurge	<i>Chamaesyce chaetocalyx</i> var. <i>triligulata</i>	SOC-F	In limestone crevices at entrance of Boquillas Canyon at 3,000-3,500 ft
Two-Bristle rock daisy	<i>Perityle bisetosa</i> var. <i>bisetosa</i>	SOC-F	Pockets and crevices of limestone rock
<i>Species whose local populations might be affected by a high-intensity fire:</i>			
Chaffey's cory cactus	<i>Escobaria</i> var. <i>chaffeyi</i>	SOC-F	Rocky igneous or limestone in open areas or under trees at 5,000-7,000 ft
Dense cory cactus	<i>Escobaria dasyacantha</i> var. <i>dasyacantha</i>	SOC-F	Rocky igneous soils of desert scrublands, and limestone soils of woodland and grasslands
<i>Species whose entire known population might be affected by a high-intensity fire in USA:</i>			
Bigpod bonamia	<i>Bonamia ovalifolia</i>	SOC-F	Sand dunes, among rocks in dunes, along roadsides and in Boquillas Canyon. One population at risk due to growth of buffelgrass. Three populations of a total of five globally
Chisos hophornbeam	<i>Ostrya chisosensis</i>	SOC-F	In heavily timbered canyons and on slopes 5,000-8,000 ft north of Emory Peak

Common Name	Scientific Name	Status	Habitat
Chisos Mountain or Lateleaf oak	<i>Quercus tardifolia</i>	SOC_F	One plant known in Boot Canyon; more in Mexico in wooded canyon bottoms and arroyos
Guadalupe fescue	<i>Festuca ligulata</i>	C-F	Canyon bottoms with oak and pine overstory
Tall-stemmed paintbrush or Squawflower	<i>Castilleja elongata</i> or <i>C. integra</i> var. <i>integra</i> (taxonomy questionable)	C-F	Perennial growing on the wooded slopes of the Chisos
<i>Species occurring in fire-prone habitats that are likely to be fire tolerant:</i>			
Chisos agave	<i>Agave glomeruliflora</i>	SOC-F	Chisos grasslands with pinyon pine, juniper and Bull muhley
Chisos coral root	<i>Hexalectris revoluta</i>	SOC-F	Moist or dry open oak woodlands in canyons, among boulders
Chisos Pinweed	<i>Lechea mensalis</i>	SOC-F	Found in pinyon-juniper country, wooded summits and rocky exposures
Glass Mountain coral root	<i>Hexalectrus nitida</i>	SOC-F	In shady canyons among rocks with pinyon-oak-juniper leaf litter
Little-leaf brogniartia	<i>Brogniartia minutifolia</i>	SOC-F	Arroyos, blackish sandy soils and perhaps on limestone
Puckering nightshade	<i>Nectouxia formosa</i>	Not formally petitioned for federal listing	Found in woods, and meadows in mountains at high elevation 6,500-8,000 ft on limestone, clayey and sandy soils
Texas purple spike	<i>Hexalectris warnockii</i>	SOC-F	Shady juniper-oak woodlands
Long-spur colombine	<i>Aquilegia longissima</i>	SOC-F	In moist soils along drainages in wooded and forested areas including Maple and Pine Canyons and Cattail Falls
Purple gay mallow	<i>Batesimalva violacea</i>	SOC-F	Moist canyons among boulders with mesic overstory
Slender oak or Chisos oak	<i>Quercus graciliformis</i>	SOC-F	Rocky canyons with high water tables
Texas largeseed bittercress	<i>Cardamine macrocarpa</i> var. <i>texana</i>	S2	Limited distribution in mesic pinyon-oak-juniper woodlands. Associated with Guadalupe fescue
Sierra del Carmen oak	<i>Quercus carmenensis</i>	S1	Occurs near peak of Casa Grande Mountain in fire prone area
Harvard's stonecrop	<i>Sedum harvardii</i>	S2	Grows out of bedrock in mountains, which have experienced fire in the past
Robert's stonecrop	<i>Sedum robertsianum</i>	SOC-F	

Status:

T-F= Federal Threatened

C-F= Candidate for Federal Threatened or Endangered

SOC-F= Federal Species of Concern

Rank (Texas)

S1= Less than 6 occurrences known in Texas; critically imperiled in Texas; especially vulnerable to extirpation

S2= 6-20 known occurrences in Texas; imperiled in the state because of rarity; very vulnerable to extirpation

SH= historical in Texas; not verified within the past 50 years but suspected to be extant

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Impact Topic (6): Cultural Resources

Historic Context

In historic times, six countries have claimed the Big Bend as theirs but archeological sites suggest many ethnic groups have long used the region, gathering food plants, hunting, trading, and farming along the river. Each successive group to enter and colonize the region met conflicts with previous inhabitants. The Treaty of Guadalupe Hidalgo of 1848, opened the area as U.S. territory and led to an influx of Euro-Americans bent on exploration, exploitation of the natural resources, and settlement. Conflicts with American Indians who already occupied the land led to the decimation of Indian populations. The opening of the railway along the San Antonio to California trail in 1882, and changes in landowner laws opened the way for Europeans to ranch, and farm in the Big Bend. Homesteads, corrals and fences, and watering points from this period are still in use on modern ranches outside the park, and inside the park, have become attractions for visitors wishing to understand the park's history. In the 1930s, Roosevelt's new deal and the "CCC" era has left rustic stone work along the Chisos Basin Road and several trails in the Chisos Mountains.

The remnant sites, structures, and buildings from these historic periods are important resources which the park preserves for the enjoyment of the visiting public. Historic structures, cultural landscapes, and artifacts may incur fire damage, while fire may be used to help reduce surrounding hazard fuels and maintain historic landscapes and views. Below is a compilation of known resources in the park from NPS surveys in 1936-37, 1966-67, and post 1982. There are currently more than 1560 sites in a cultural site database at the park, and new sites are added as they are found. Under the proposed alternative, cultural resource surveys are required prior to prescribed fire activities. Pre and post-fire monitoring by professional archeologists for prescribed burns would identify additional archeological sites. Post-fire monitoring of natural ignitions also would identify additional cultural sites. A Cultural Resource Component was developed as part of the park's resources and is listed as Appendix C.

Park Resources

Archeological resources

Based on a NPS system-wide Archeological Site Estimation Project in 2002, the NPS has estimated that Big Bend National Park contains 26,000 archeological sites dating from 8000 B.C to about 1535 A.D (GMP, 2003). Additional funding has not been available for formal surveys but as sites are found they are inventoried on a GIS database. Two archeological sites and one archeological district (Burro Mesa) are listed on the National Register of Historic Places, with another site and the Glenn Springs Cavalry Outpost in the process of nomination. Fifteen sites are State Archeological Landmarks. These sites should be top priority for protection against wildland fire through appropriate methods.

Historic structures

There are 69 structures on the List of Classified Structures with 49 of these on the National Register of Historic Places (NRHP). These 49 are within 8 National Register Districts or Sites. These sites or districts are Burro Mesa Archeological District, Castolon Historic District, Hot Springs Historic District, the Mariscal Mining District, the Homer Wilson Blue Creek Ranch Site, Rancho Estelle (Sublett Farm), Daniel's Farmhouse and Luna's Jacal. Three other sites are being nominated, many others evaluated and preserved as time and resources permit. Of the 69 listed structures for eligibility, 26 are in good condition. There are approximately 400 additional unlisted and unevaluated structures for which preservation management strategies are undeveloped. These must be protected until which time they can be formally documented, evaluated for National Register status, and management strategies can be developed. Throughout the park, forbs, succulents, shrubs and trees have grown around a number of historic structures and increase their flammability. Upon review by the cultural resource specialist and the fire ecologist a program of fuels reduction should be undertaken to meet the historic needs and also to allow for natural ignitions wherever possible.

Potential cultural landscapes

Cultural landscapes contain physical evidence of the full spectrum of human use, including aboriginal hunting and gathering by American Indians, Spanish colonial/military and exploration, European and American settlement, , military encampments, ranching, farming and agriculture, and mining. The NPS has determined that eleven landscapes are eligible for inclusion on the National Register of Historic Places. These are Castolon Valley, Terlingua Abajo, Boquillas Valley, San Vicente, Chisos Basin, Mariscal Mining District, Comanche Trail, Cottonwood Creek Valley, Glenn Spring, Neville Spring, Johnson Ranch. An additional eight landscapes have potential for listing in the National Register, but further research is needed to identify boundaries and cultural relationships. These are Dugout Wells, Indian Head Mountain, La Noria, McKinney Spring, Government Spring Ranch, Hannold Ranch, K-Bar Ranch, and Tornillo Flat. An additional 48 landscapes or landscape-related elements are identified, but further research is needed to better understand these resources. These sites are threatened with neglect and effects of erosion, weathering, vandalism, flooding, collectors and collapse due to insufficient funding for repairs. Effects of vegetation and vulnerability to fire must be evaluated on a case-by-case basis. It is debatable for ecological reasons whether the denuded grazed or mined areas should be reestablished.

Ethnographic resources

During the prehistoric, the land was occupied by various hunting and gathering groups, and only in the Late Prehistoric has there been recorded identifications of these people. Spanish mission priests during the 1600s noted that the people occupying the area now in the park as the Chizo, a group of loosely associated bands that took the name of their respective leaders. Historic records indicate that other American Indian groups used the region either occasionally or seasonally and some of these groups still exist as federally recognized tribes. The park actively consults with seven of these tribal entities due to their ethnographic links to park resources. They are the Apache Tribes of Oklahoma (including the Lipan Apache), Comanche Tribe of Oklahoma, Kickapoo Traditional Tribe of Texas, Kiowa Tribe of Oklahoma, Mescalero Apache Tribe, Blackfeet, and Ysleta Del Sur Pueblo. The Crow Chapter of the Native American Church requested permission to use resources from the park in the 1970s and in 2003 the Ute Mountain Ute Tribe made plant gathering inquiries. Also in 2003, a group representing the and Mescalero and Lipan Apaches carried out a gathering of plants for ceremonial use. Other requests are expected in the future and these requests may influence fire actions in localized areas. Fire and fire related activities have potential to significantly affect plant resources and sites with which these groups hold ethnographic ties.

Additionally, six different governments have controlled the park— Mexico, Spain, France, The Republic of Texas, the Confederate States of America, and the United States of America. Various groups of European Americans, African Americans, Hispanic Americans, and Mexicans have familial or ethnic links to park resources.

The Fire Program and Cultural Resources

The size of the park, and the need for compliance and routine documentation consumes the majority of staff time of the one cultural resource specialist in the park. What is needed is a systematic approach to assessing and managing the parks cultural resources. The challenges are the potential number of yet-to-be-discovered sites (as many as 26,000 sites may exist in the park) and the specialized surveys needed to assess historic buildings, artifacts, archeological sites, and cultural landscapes to understand how they should be treated and maintained. This represents hundreds of sites requiring careful mapping, documenting of flammable materials and devising specific treatments for each site. Some general precautions can be applied to protect combustible materials such as glass, ceramic, metal or timber. Cultural landscapes are more prone to damage from suppression actions and erosion, which changes drainage and vegetation patterns. Without trained operators and supervision, fire crews cannot be expected to maintain these sites to National Register standards.

The Fire Management Officer and the Cultural Resource Specialist have taken steps to meet joint needs. The fire program currently pays for pre-burn cultural resource surveys. This is appreciated but skews CR work by consuming staff time to insure that surveys identified vulnerable sites, which must then be protected during fuel reduction burns. Rather than having the fire program conduct activities which meet cultural resource management needs, the fire program drives the CR compliance process. In response, the cultural resource specialist has developed a matrix for identifying sites and processes for reducing fuels that includes tools used by the fire program. As time permits the CR specialist will add to this list, providing the documentation for fuel reduction at particular sites, some of which may be undertaken by the fire program. The Fire Management Officer is attending natural and cultural resource meetings to understand how the fire program can serve these priorities within the park. Bi-annual or annual review of the fire program provides the opportunity for including fuel reduction of cultural resource sites in the fuels treatment roster.

Impact Topic (7): Watershed Effects.

Two ecosystems have been considered for erosive impacts of thunderstorms following fire; (1) the Chisos Mountains, and (2) the gently sloping flats of degraded desert grasslands in the east and northeast of the park.

High Chisos Watersheds

The Chisos Mountain watershed area is defined by the tops of the mountains down to the following roadways and trails: Park Route 13 to the north; Park Route 15 or Ross Maxwell Scenic Drive on the west, Park Route 12 from Panther Junction to the east; Glenn Spring Road and Juniper Canyon Road on the southeast; and Dodson Trail defines the southern boundary. These roads and trails truncate the watershed but are where most severe fire effects could occur and are part of the designated firebreak system.

The main threat to the Chisos is from high-severity fire, which could occur under extreme conditions in heavily wooded areas. High-severity fire burns soil organic matter predisposing it to movement if followed by intense summer thunderstorms. Grasses are burned to below ground, soil seed reserves destroyed, and shrubs and trees scorched or killed depending on the species and depth of the root callus. Watersheds most at risk are higher elevations at the northern end of the Chisos Mountain Range covering approximately 20,000 acres. Watersheds within this area are; Oak Creek Canyon (3,800 acres), Boot Canyon (845 acres), Upper Pine Canyon (3,040 acres) and Upper Cattail Canyon (1,490 acres). Elevation ranges from 4,200 to 7,832 feet. Soils in these canyons are formed primarily on igneous rocks and are well drained, moderately permeable and provide for rapid surface runoff. Slopes are convex to plane, steep and are mostly 20 to 45 percent although they range from 8 percent to near vertical. Erodability ranges from moderate to severe depending on slope and the presence of coarse material. Erodability in Oak Creek Canyon is severe due to steep slopes and fine-grained material. Proximity to developed areas and areas with high visitor use are a concern. Upper Pine Canyon is the subject of long term intensive studies designed to determine the impacts of pollutants and climate change on watershed dynamics. Slick rock conditions currently exist in Boot Canyon with running water present much of the year. Soil and debris movement from the slopes above could cover and eliminate this important wildlife water source until the material is exported from the canyon. Soil movement into Cattail Canyon likely could become choked among large boulders and build up at the bottom of very long drops.

Tornillo Creek and Nine Point Draw Watersheds.

It was the grasslands that attracted ranchers to the Big Bend and changes in landowner laws that made their enterprises possible. Free from grazing for 60 years, grasses have recovered in the high desert but not on the drier, less permeable flatter slopes to the north and east of the park (Maxwell, 1994). Satellite imagery shows shrub encroachment into desert grasslands south of Persimmon Gap (McKernan 2003) -

an expected outcome in droughty soil conditions from increased runoff and reduced competition (Cable 1975), and low litter production (Maya and Arriga 1996). McKernan's thesis however, points to the possibility of increasing grasses in the area when burns are followed by above average precipitation and seed sources are available. Harvstad (1996) counters this optimism by pointing to poor or no recovery of black grama once shrub cover is established following decades of intermittent drought and grazing recovery. The fire return interval for maintaining desert grasslands in semi-arid areas using fire is 7-10 years (McPherson 1995) with the U.S. Forest Service FEIS web site suggesting from 35-250 years in arid areas with slow biomass accumulation. Small research burns may aid restoration under conditions of above average rainfall, with soil stabilization and suitable seed sources.

Nine Point Draw (approximately 90,000 acres) and Tornillo Creek (approximately 75,000 acres) are at risk from the effects of intense thunderstorms especially after fire removes sparse vegetation. These two watersheds encompass all the lowland desert in the north end of the park as well as much of the east portion of the park. Slopes are almost level and finely textured soils derived from both igneous and carbonate rocks have slow infiltration leading to overland flows and gully erosion. Ranching and farming activities, especially in the Nine Point Draw watershed, have left large areas denuded. Eight to ten inches of soil depth have been lost over large portions of each watershed and wide gully systems are advancing across each. Grasslands are fragmented. The beneficial effects of fires in grasslands may not apply to highly degraded desert grasslands.

Attempts have been made to rejuvenate the tobosagrass flats at Tornillo Flat in the 1950s by the Soil Conservation Service. Mechanical methods aimed at increasing infiltration brought a sodic layer to the surface preventing tobosagrass from establishing (Jeffery Bennett, personal communication September 2004). Elsewhere, staff are concerned about overland flows further removing soils and hampering recovery of any vegetation. They are cautious about embarking on a fire program that may cause type conversion of desert grassland to scrub desert or the reverse, or result in the loss of fire intolerant species over time. For these fragile areas they intend small-scale experiments to determine which strategies are most successful at extending grasslands where they currently exist, and where they are known to have occurred historically.

Impact Topic (8) Resource Support for the Fire Program

Allowing more fire on the landscape and conducting research burns will require more monitoring of pre-fire and post-fire effects and additional vehicles, fuels, and trained staff.

The Review and Update of the 1995 Federal Wildland Fire Management Policy, January 2001 calls for appropriate levels of preparedness that "...will ensure their [agency's] capability to provide safe, cost-effective fire management programs in support of and resource management plans through appropriate planning, staffing, training, equipment, and management oversight."

Currently the park has the capacity to handle a remote wildland fire requiring multiple resource types (engines, crews, aircraft) and with limited potential to spread toward values at risk. A wildland fire threatening a public development area and with potential to spread for multiple days is beyond the park's capacity to control. Generally, the park has the resources to conduct initial attacks on unplanned ignitions but needs to call on outside resources for extended attack fires. Key positions such as Engine Boss and Crew Boss lack sufficient qualified personnel on the park staff. This lack of qualified leadership limits the park's ability to activate every Big Bend firefighting resource fully and effectively.

The park anticipates needing to train more personnel to conduct pre-fire and post-fire monitoring of research burns, and engage specialist trainers to train park staff in burning under hazardous conditions. The Fire Management Officer is seeking additional recruitment and training of Los Diablos participants under the new FMP, to meet new standards for fire crews. Specialized training is sought for Los Diablos members to handle hazards of high fuel loads in rugged terrain such as the Chisos. Pre and post-fire

monitoring of research burns requires additional protocols to meet specific design criteria and may continue for considerable time to obtain scientifically useful data. A new staff position, Fuels Specialist is sought to assess fuels across the park, develop and apply research protocols, and investigate the spectrum of hazardous fuel reduction measures to meet threatened and endangered species protection, rare species, cultural resources and effective prescribed burns in particular vegetation types.

The proposed changes for the new FMP are to provide a research platform for allowing staff to learn how to allow fire to resume its natural ecological role, and in so doing contribute to ecological sustainability in harmony with the Federal Wildland Fire Management Policy, January 2001. Funding however, is oriented towards suppression of emergency wild fires and fuels reduction through prescribed burning, and less towards supporting routine fire operations such as natural ignitions and research burns that would safely allow fire to resume its role in the Big Bend landscape.

Suppression has been the primary response to fire under the current (1994) FMP and park needs have been met by existing staff and resources in Table IV-1 below. The proposed alternative will allow more fire in the park and fires may burn larger, longer, and more frequently than before. Depending on the frequency of fires, fire size and intensity, and regional preparedness levels, the park may experience challenges in meeting resources for additional monitoring, suppression, and specialized research burns.

Table III-3: Current Fire Program Resources

Resource Type	Number	Location	*Response Time	Availability
Type 6 Engine (863)	1	Panther Junction	0.5 hours	Year-round
Type 6 Engine (864)	1	Panther Junction	0.5 hours	Year-round
Seasonal Firefighters	5-16	Through-out park	0.5 – 3 hours	Fire Season only
Type 1 Engine (811)	1	Panther Junction	0.5 hours	Year-round
Type 1 Engine (812)	1	Chisos Basin	0.75 hours	Year-round
Type 1 Engine (821)	1	Rio Grande Village	1.0 hours	Year-round
Type 6 Engine (865)	1	Castolon	1.5 hours	Year-round
Type 6 Engine	1	Terlingua	1.5 hours	Intermittent
Regular Firefighters	10-15	Through-out park	1 – 3 hours	Year-round
Cessna N104PS	1	Harte Ranch	1.5 hours	Pilot dependent
Trailer Unit	1	Rio Grande Village	2.0 hours	Year-round
Mules	6	Panther Junction	2.0 hours	Year-round
Type 6 Engine (TxFS)	1	Fort Stockton	3.0 hours	Intermittent
Los Diablos Firefighters	39	Mexican Villages	3.0 hours	Year-round
Type 3 helicopter	1	Mescalero Apache	4.0 hours	Fire Season only (90 day contract)
Type 3 Incident Mgmt Team	1	Lincoln Zone	6 – 8 hours	March thru July
Type 2 Incident Mgmt Team	1	New Mexico	24 hours	March thru October

*Response time is the time required to travel to Panther Junction and be ready for work.

Implementation

To implement Alternative C there will be additional requirements for planning, monitoring, resource advice, and compliance in addition to increased demand for general operations staff time and resources.

Planning & Compliance

The proposed 10-year fuels treatment program will need additional staffing to complete the planning and compliance workload. A recent analysis of the fuels program workload recommends a Prescribed Fire Technician; a position not currently funded and is not currently designed with the training, skills or knowledge to complete planning and compliance requirements. To date, planning and compliance duties are distributed among current staff. These planning and compliance duties have been and will be the future bottleneck to meeting annual targets. The fire staff recommends adding a Prescribed Fire Specialist for planning and compliance duties to meet the needs of the proposed fuels treatment program.

Monitoring

The current monitoring staff is under funded and deficient in employees needed to accomplish the monitoring workload. There is one permanent employee for monitoring. An analysis of workloads for fire effects monitoring suggests the need for two additional permanent employees Fire Effects Module Leader, and FE Module Assistant Leader and two seasonal FE Monitor Crewmembers. The park has already begun transferring some monitoring and compliance work to the fire program from other resource areas allowing these programs to meet compliance goals. The fire program is currently surveying and monitoring areas for cultural resource objectives and for natural resource objectives. The proposed 10-year fuels treatment program is an increase in workload particularly for the careful monitoring required for fire effects and fire dynamics associated with research burns, and assessment of areas for rare species. The Fire Effects Module has responsibility for monitoring fire effects in the parks served by the Big Bend FIREPRO staff. The fuels treatment program workloads in these area parks will also increase in the future.

Key Additional Personnel

Wildland Fire Use (WFU) is an appropriate management response on some unplanned fire ignitions in both Fire Management Units and under Alternatives B and C. A WFU Team is required to manage wildland fire use incidents and a team will be an appropriate management response option when considerations such a prescription conditions, values at risk, cost-benefit and others make WFU the best management choice. The park staff is currently lacking in personnel qualified and trained in WFU skills. A Fire Use Manager Type 2 is the key deficient position. One park staff member is currently a trainee and should be encouraged to complete the qualification requirements. Prescribed Fire Monitors are also needed to manage these fires. The park has a history of Type 2 wildland fire use incidents.

Resource Advisors

Resource advisors will be required on an unplanned incident-by-incident or planned project-by-project basis. An example is an unplanned ignition occurs in the park. The potential for fire spread and expected fire effects is evaluated. Resource advisors from the park staff (archeologists, botanist, wildlife biologist and hydrologist) are consulted on what are the possible adverse impacts. With this input from resource advisors, an appropriate management response and fire strategy is put into place. This will be dynamic process and re-evaluation of the situation will take place on a daily or as-needed basis. There are insufficient fire-line qualified archeologists to provide potential fire-line impacts to un-surveyed areas for a multiple day incident. The incident managers should expect to request additional archeologists. Below in Table III-4 and Table III-5 are the staffing and training needs required by Big Bend’s fire program to effectively meet the planning, compliance, monitoring, and fire fighting needs associated with the new fire program.

Table III-4: Additional Staffing Needs

Position	Grade	Position	Pay periods	#
Fire Crew Supervisor	GS-6	*Furlough	13	1
Prescribed Fire Specialist	GS-9	Permanent	26	1
Asst. FE Module Leader	GS-6	Furlough	13	1
FE Crew Member	GS-5	Temporary	12	2

Table III-5: Staff Traing Needs

Position	Grade	#
Fire Use Manager Type 2	FUM2	1
Crew Boss	CRWB	3
Engine Boss	ENGB	3
Prescribed Fire Monitor	MTNR	4

Legend

*Furlough – permanent employees funded less than a full year.
 Temporary – seasonal positions without employee benefits
 Grade – pay level scale for government positions

It is worth noting that 45,000 volunteer hours were given to the park in 2000 (BBNP Business Plan 2000) – a generous gesture that also suggests the park lacks the funds to hire permanent employees to address needed maintenance and routine tasks in various departments.

Preemptive Safety Measures

Recognizing the difficulty of controlling and suppressing fire in the Chisos under extreme conditions, the park has prepared measures to protect the public, and to engage them in keeping this area safe from careless misuse of fire. A carefully sequenced evacuation plan has been prepared for the Chisos Basin. High visitation and dry pre-monsoon conditions pose considerable hazards in the high Chisos. Hikers and visitors to the high Chisos will receive a warning of the fire danger on their hiking permit if the park believes the conditions severe. The park may also post a ranger at the beginning of the major trailheads during extreme conditions to warn people of the danger and to advise against smoking and lighting fires.

Under extreme conditions the Superintendent may close all public areas to smoking, open fires and even to hiking. Depending on the year, all of these precautionary measures will require additional staff during the main fire season from March through July. Staff are drawn from other divisions within the park to meet these periodic needs.

Chapter IV: Environmental Consequences

This chapter evaluates the environmental effects of the three fire management alternatives retained in Chapter II on the eight impact topics.

Methodology

This EA analyzes the effects of differing amounts of prescribed fire, wildland fire use, suppression, non-fire treatments under the three alternatives. Alternative A allows the least use of fire and poses the greatest risk of future wildland fires. Alternative B was developed with the understanding that fire shaped park vegetation. It is envisioned to reduce fuels over more of the park fastest, but possibly with some negative effects over the short-term. Alternative C curbs the possible negative impacts of Alternative B in sensitive habitats with the use of the Special Treatment Zone in the Chisos, and use of research burns in a variety of habitats and species where fire effects are not well understood. The Special Treatment Zone is a 'red light' to managers to pay special attention to natural and prescribed fire in the Chisos. Lightning ignitions may be allowed to burn in selected areas at low and moderate intensity. Prescribed burns will be guided in area, intensity, and habitat by research questions and protocols.

The three alternatives were the IDT's best attempt to satisfy NPS policy and the goals and objectives of Big Bend's fire program. In developing Alternative C, they found a balance between reducing immediate threats from high fuels and providing long-term information from research burns to improve future management decisions. Given the uncertain nature of fire, weather, and regional priorities and resources, the IDT cannot guarantee that the alternatives will have the predicted effects, and may even result in similar outcomes.

Environmental Consequences

Under NEPA, effects of alternatives are defined in terms of :

- *context* (are effects site specific, local or regional?) A site specific effect might be a decrease in population, a local effect might be erosion across a watershed, a regional effect might be at the level of entire ecosystems or landscapes across a mountain range.
- *intensity* (are the effects negligible, minor, moderate, or major, or would they lead to impairment of Big Bend's resources and values?) Definitions vary by impact topic
- *duration* (are effects short-term or long-term?) Short-term effects result in return to predisturbance condition or appearance within hours to the duration of the FMP. Long-term effects may exceed the duration of the FMP.
- *timing* (do the effects vary with the timing of alternative actions?) Prescribed fires are scheduled outside normal fire season and may impact some fire dependent species.
- *direct impacts* (are resources adversely or beneficially affected?) Adverse effects take a resource away from a desired condition or appearance. Beneficial impacts have the opposite effects.
- *indirect impacts* (do other adverse or beneficial outcomes occur from the action?)
- *cumulative impacts* are discussed in the next section, and
- *mitigative effects* are actions that reduce environmental effects of alternatives.

Cumulative Effects

Cumulative impacts are defined by the Council of Environmental Quality as "the impact on the environment that results from the incremental effect of action (s) when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) undertakes such

action” (40 CFR 1508.7). Actions with a potential to add to the effects of the FMP were contributed by the IDT. They include:

- Development of walking trails (1) to connect Kibbe Springs along the south side of Casa Grande with the Lost Mine Trail, and (2) to provide a link from the Castolon historic area to the river.
- Construction of new buildings including several new houses or duplexes to replace old trailers, construction of a fire management office, and enlargement of the visitor center –all at Panther Junction.
- Continued but slow growth in the western gateway communities of Study Butte and Terlingua, and the resort town of Lajitas.
- Fires on state and private lands adjacent to the park.
- Fire events at Big Bend preceding and following the term of the new FMP.
- Continued fuel accumulations in the Chisos.
- Expansion of nonnative plant species.
- Pilot revegetation of natives along riparian corridor.
- Past and future flood and erosion events.
- Defoliation of trees by caterpillars in the Chisos during periods of stress.
- Expanded interpretive and education programs.

Impairment Analysis

NPS is required by law (Organic Act, General Authorities Act) to guarantee that natural and cultural resources will be passed onto future generations unimpaired. Managers must seek ways to avoid, or minimize to the extent possible, actions that would adversely affect resources and values that are essential to the identity or purpose or part of the enabling legislation of the park. Each natural and cultural impact topic has NPS specific language. Impairment determinations were made with the judgement of professional staff and relevant studies.

Appendices

There are three appendices that provide supporting information for this chapter. They are Fire Effects on Dominant Plant Species (Appendix B), the Cultural Resources Component (Appendix C) which was prepared for evaluation by the Texas Historical Preservation Office, and a list of plant and animal species discussed throughout the text (Appendix D).

Impact Topic (1). Life and Property

Fire is an effective tool for reducing hazard fuels, but it is also a threat to the public, firefighters, park staff, developed areas, and neighboring properties.

The first and foremost objectives for fire management are the protection of life, property, and resources from the unacceptable effects of wildland or prescribed fire. Life and property encompasses park staff, firefighters, visitors as well as park developments and personal property of everyone concerned. Life and property on neighboring lands are also of concern. The paradox facing resource managers is that while fire is a threat, it is also an effective tool for reducing fire hazards.

Assessment Methodology

Assessment of environmental consequences on life and property is based on historically observed wildland fire intensity (the amount of energy released) and severity (impact on soils and amount of canopy burned) at Big Bend National Park or in similar vegetation communities elsewhere, and on the expertise of resource managers at the park. Staff also considered the number of wildland fires and escapes of several prescribed fires in determining fire safety.

Intensity of effects for life and property are defined as:

- Negligible:** The impact is at the lowest levels of detection with no injuries or property damage.
- Minor:** The impact is small, localized, and detectable. Mitigation would be a standard procedure and highly effective in minimizing risky activities such as thinning and prescribed burns to reduce fuels.
- Moderate:** The impact is readily apparent. Mitigation is moderately complex and effective activities such as rebuilding structures.
- Major:** The impact is severely adverse or exceptionally beneficial. Effects may be permanent. Mitigation may result in permanent positive change in human values or procedures, or mitigation to offset negative effects such as loss of historic register buildings may not be possible.
- Short-term:** Within the duration of a specific fire program activity such as a prescribed burn or suppression action.
- Long-term:** Beyond the duration of a specific fire program activity; perhaps longer than the tenure of the FMP.

Alternative A

Impact Analysis

Fire threats are greatest in late spring coinciding with peak visitation. Fire intensity is greatest where fuels have increased in the Chisos forests, along the riparian corridor and where exotic bunching grasses form dense understory mats. Alternative A (No Action) continues the direction of the 1995 RMP and 1994 FMP focusing on protection through suppression. Long-term direct beneficial effects accrue as developments continue to be protected by prescribed burns and manual thinning, mowing or herbicide applications. Strict decision criteria on natural ignitions mean that few natural fires are allowed to burn elsewhere in the park. Direct minor to moderate adverse effects accrue with the continual build up of fuels, particularly in the Chisos, that could threaten developments in the Chisos basin, hikers in wilderness, and some historic sites. A puzzle to staff is that despite buildup of fuels, few lightning fires have required suppression in the Chisos. This observation suggests that fire may not have burned as frequently as supposed or that fire is naturally contained by topography.

Under Alternative A the probability of high-severity fire in the Chisos increases when fuels are dry and wind speeds are high. Buildup of pine needles and leaf litter, ladder fuels, woody dead and down material, and closure of tree canopies will increasingly predispose the area to extreme fire conditions during summer fire season. Evacuating visitors from the Chisos basin and hikers from wilderness would be difficult during extreme fire events. Even with additional regional resources, the likelihood exists that the fire would burn large areas before containment. Creation of a one-mile suppression zone to buffer neighbors from fire has been successful where vegetation is sparse along west, north and eastern borders. It is more difficult along the riparian Rio Grande corridor where dense, flammable saltcedar and giantreed may hinder suppression efforts and endanger firefighters.

Mitigation actions are: Continuing to reduce fuels through prescribed burns and minimizing administrator's reluctance to allow wildland fires; public education and notification of fire activities;

maintenance of cooperative agreements with neighboring landowner's and agencies; manual and mechanical fuel reduction; fuel breaks around developments; evacuation plans.

Cumulative Effects

Cumulative effects on life and property are expected to be minor to moderate with other activities having little impact on threats to life and property. Additional trails, built areas and growth of nearby communities reduce fuels and threat of fire. The relative isolation of the park minimizes the influence of the fire program on humans other than staff and visitors.

Conclusions

Alternative A may result in long-term minor to moderate adverse impacts to life and property by allowing fuels to increase. Burning of slash, mowing, herbicides and manual thinning and small prescribed burns pose minor short-term risks to life and property. Fuels continue to buildup in the Chisos, which raises the probability of more intense fires initiated by lightning strikes during the summer monsoon. Suppression of fire under extreme conditions in rugged terrain—a requirement under the current FMP—poses direct, moderate to major adverse risks to firefighters, hikers and visitors in the Chisos Basin. Fire occurrence and history of effects is limited but no impairment has occurred to date from fire.

Alternative B

Impact Analysis

Under Alternative B there will be more fire in the park. Initially this poses risks to life and property because of fuel accumulations in the Chisos, areas of flammable exotics, and increased need for fire fighting. Over the longer-term, increased experience by firefighters, familiarity with fire in different vegetation types within the park, and reduced fuels are expected to lower risks to life and property across the park. Allowing more fire is expected to reduce the risk of high-severity fire in the Chisos and the difficulties of evacuating people. Long-term beneficial effects to life and property are expected as neighbors learn and contribute to a more cohesive fire program.

Mitigation actions are: fuels assessment to allow natural fires to burn at low and moderate intensities; focus negotiations with neighbors on allowing fires to burn to natural boundaries; have adequately trained staff within the park or regionally available to handle the increase in fire activities.

Cumulative Effects

Increased wildland fire use may draw resources from other projects in the park over the short-term. Minor, long-term beneficial effects to life and property are expected as fuels are reduced across the park.

Conclusions

This alternative may expose firefighters to more fire and risk than other alternatives. While firefighters and the public may initially be exposed to greater risks; adverse impacts ranging from minor to moderate intensity over the short-term; these risks decline as fuels are reduced providing minor to moderate long-term benefits. Alternately, more exposure to fighting fire increases staff expertise leading to long-term moderate beneficial effects on life and property.

Alternative C

Impact Analysis

Impacts to life and property would be similar to those under Alternative B. More restrictive wildland fire use could necessitate more suppression activities that expose firefighters to dangers. Research burns would guide application of prescribed fire and wildland fire use over the tenure of the fire management plan, and program adjustment based on new knowledge should decrease risks to life and property.

Mitigation actions are similar to Alternative B. Research burns decrease potential adverse effects by providing a better understanding of fire effects.

Cumulative Effects

Cumulative effects are the same as Alternative B.

Conclusions

Effects are similar to B with increased risk to firefighters and the public in the short-term with increased burning. More frequent fires wildland fires and prescribed/research fires would reduce fuels, build firefighter skills, and a database that has the potential to provide long-term moderate to major beneficial effects on life and property. Conducting research burns would involve short-term minor to moderate direct adverse risks. Activities associated with research burns improve the skill base in the park and provide a platform for adaptive management, a long-term moderate to major beneficial effect in reducing risk to life and property.

Impact Topic (2): Preservation of Visitor Experience

Fire program activities may result in road closures and deter visitors; conversely some visitors are interested in fire and the post-fire activities offer interpretative opportunities.

Increased fires in the park would affect the approximately 300,000 annual visitors. Depending on the fire size, wind speed and direction, and fire duration visitors may be barred from roads, river, and mountains—the key recreational features of the park. Campgrounds may be closed and evacuations may be necessary from the Chisos wilderness and Basin. Smoke may veil the panoramic views of mountains and desert that draw many visitors. Interpretation of fire events is expected to lower aversion to the effects of fire on the landscape.

Communication by park staff via visitor centers, press releases, radio, signs and web site to visitors, local community and agencies of planned and unplanned fire activities is aimed first and foremost, at protecting life and property. Visitor Center staff are updated frequently to provide guidance on trail and road closures, safety and alternate destinations if needed. Backpackers are apprised of fire danger and responsibilities of using campfires and stoves before entering the Chisos when obtaining their camping permit. During periods of high fire danger, staff are posted at major trailheads to give further instructions. Evacuation plans are in place for the high country and Chisos Basin.

All alternatives have similar prescriptions governing prescribed fire and wildland fire use. Staff have perceived likely fire effects under these prescriptions and can plan, monitor and make cautious predictions based on these ranges. The planned reduction of fuels under the action alternatives will reduce threats to visitors from high-severity fire.

Assessment Methodology

Visitor surveys provide the background for understanding the park attributes most valued by visitors. Staff considered past experience with visitors during fire events and general knowledge of visitor patterns and expectations to determine impacts.

Intensity of effects for visitor experience is defined as:

Negligible: An action that could cause a change in visitor activities and/or aesthetic resource values, but the change would be so small that it would not be of any measurable or perceptible effect. Few visitors would be affected.

- Minor: An action that would affect some visitors and cause a change in visitor's activities or aesthetic resources, but the change would be small and localized. Mitigation would not be necessary.
- Moderate: An action that would cause a substantial measurable change in activities available to many park visitors. Mitigation to offset adverse effects would be necessary such as providing alternative routes and itineraries. Aesthetic resources would be degraded.
- Major: An action would cause a severe change or exceptional benefit to the activities of most park visitors. The change would have substantial and possibly permanent effects on visitor use such as the loss of views and unique sites. Aesthetic resources would be substantially degraded. Mitigation to offset adverse effects would be needed.
- Short-term: Duration of the fire event.
- Long-term: Duration of the fire management program, or longer.

Alternative A

Impact Analysis

Prescribed burning to reduce fuels around developments generally occurs in fall and early spring outside peak visitation times. The intensity and duration would vary with fuel load and fire conditions within the prescription ranges. Visitors may experience short-term, minor direct effects when their plans are changed, views obscured, vegetation charred and wildlife disrupted from a prescribed burn. Disruption to visitors is minimized however, with a full suppression policy of lightning ignitions in areas most used by visitors. Views, wildlife, and access remains unimpeded to the river and the Chisos. These are direct, moderate to major benefits to visitors.

An indirect minor to major adverse impact of a suppression policy across much of the park is that visitors have become habituated to expect a fire-free and well-vegetated park. Tight decision criteria on ignitions and few fires in the park make it a challenge to familiarize visitors to the beneficial effects of fire for ecosystems. Under extreme conditions, high-severity fire may occur in the Chisos with long-term adverse effects on visitor experiences.

Mitigation actions are: inform visitors through multiple media, the visitor's center and entrance station; provide alternate destinations; link fire program activities to interpretation and education; time prescribed burns outside peak visitation periods; coordinate burns with adjacent and nearby land managers to minimize cumulative impacts to the region.

Cumulative Effects

Cumulative effects to visitors are most likely from continued increase in fuels. In the Chisos stresses from high stocking rates of trees are postulated as a reason for defoliation during drought. Increased dead material and continuing buildup of fuels makes high-severity fire more probable with long-term impacts on aesthetics in the park. Increased exotic species impacts wildlife patterns and exotic bunching grasses can lead to higher fire temperatures around rare and endangered cactus.

Conclusions

Current management strategies under Alternative A preserve visitor resources, amenities and aesthetic values, and have provided direct beneficial impacts for 60 years. Prescribed burns occur outside peak visitation times minimizing disruption to visitors and posing minor, indirect adverse impacts. Such fires also offer interpretive opportunities. Over the long-term continuance of Alternative A increases the probability of increasing fuels and risk of fire in woodlands and forest, and a widespread, high-severity

fire in the Chisos. Suppression of such a fire would create direct and indirect long-term adverse impacts to visitor resources and park aesthetics.

Alternative B

Impact Analysis

Greater wildland fire use and more prescribed burns would result in more periods of inconvenience. The duration and frequency of visitor use restrictions would decrease over time as fuel loads are reduced. Minor adverse effects can be expected from smoke and short-term localized trail and road closures. A possible effect of increased fire is reduced visitation from altered landscapes and limited access, or alternately, increased visitation as rubbernecks seek to witness landscape fires. Reduced visitation is an adverse impact to visitor's experience. Increase visitation draws park resources to providing greater interpretive experiences and providing more direction to visitors during actual fire events.

The long-term effect of more fire in the park is reducing the risk of high-severity fire in the Chisos and so preserving, aesthetics, plant communities and wildlife - direct beneficial long-term effects.

Mitigation actions are similar to Alternative A with increased emphasis of the benefits of fire in communications with the public.

Cumulative Effects

Cumulative effects are similar to Alternative A but more inconveniences are likely from increased wildland fire use.

Conclusions

More wildland fire would result in greater direct short-term minor to moderate adverse impacts to visitors as they experience road closures, smoke and limited access to the park. Reduction of fuels particularly in the Chisos minimizes the threat of high-severity fire maintaining a resource valued by visitors and limiting the need for disruptive suppression tactics that could include overflights. Greater interpretive efforts by park staff would provide long-term indirect beneficial effects as visitors support policies that encourage natural fire regimes in park ecosystems.

Alternative C

Impact Analysis

Under Alternative C prescribed burns and natural ignitions follow a similar pattern to Alternative B. Visitors will suffer short-term, direct, adverse impacts from smoke and closure of roads and trails denying access to views, wildlife and amenities. Research burns may also cause short-term adverse effects to visitors. Scientific assessment of these burns is also expected to yield indirect beneficial effects over the long-term from improved management of cherished resources and habitats. Under Alternative C the potential for high-intensity widespread wildfires in the Chisos continues and will not abate until staff understand how to safely reintroduce fire into areas of high fuels.

Mitigation actions are the same as Alternative B.

Cumulative effects

Cumulative effects are similar to Alternative B with benefits from fire taking longer to accrue.

Conclusions

Effects of Alternative C are beneficial and minor over the short-term. Scientific evaluation of research burns applied to fire policy and interpreted for the public, provide a touchstone enabling visitors to weigh

immediate direct adverse effects with potential long-term beneficial effects on ecosystems. Benefits to visitors are expected to be greatest under this alternative.

Impact Topic (3). Local Economy

Fire events provide business for local merchants and firefighters but may deter visitors. More routine fire events provide extended benefits to the local economy than a single large high-severity fire.

The park lies in a sparsely populated region in connection with other large protected landscapes. Big Bend is a major employer of this region and supplies high-quality permanent employment, seasonal jobs and volunteer opportunities in a number of departments. Local gateway communities provide motel and supplies to park visitors and employees, furnish seasonal firefighters such as Los Diablos for the fire program, and provide support services for the luxurious Lajitas resort. Benefits to the local economy depend upon the size, intensity and duration of fires. A large, high-intensity fire may provide a one-time windfall for local merchants while more routine fire events are likely to provide more lasting impacts to suppliers and seasonal employees.

Assessment Methodology

Long-time park staff provided information on the types of expenditures associated with fires and their relative benefit to the local economy. For example, revenues for merchants increase when firefighters cash their paychecks to buy food, water and other supplies during fire events.

Intensity of effects for the local economy is defined as:

- Negligible: Economic and socioeconomic effects would not be affected or the effects would not be measurable.
- Minor: The effects on economic and socioeconomic conditions would be small but measurable, affecting a small portion of the local population.
- Moderate: The effects on economic and socioeconomic conditions would be apparent in the vicinity of the park.
- Major: The effects on economic and socioeconomic conditions would be readily apparent and would substantially change the economic or social services within the area.
- Short-term: For a specific fire program activity.
- Long-term: Beyond the duration of a specific fire program activity such as a fire season or the duration of the FMP.

Alternative A

Impact Analysis

Under Alternative A, a policy of prescribed burns around developments and suppression elsewhere in the park has resulted in a few fires of short duration with little impacts on visitors or the local economy. Continual buildup of fuels in the Chisos increases the problem of widespread, high-intensity fire under extreme conditions. A large fire would create short-term direct moderate benefits for retail merchants. Visiting and local seasonal firefighters may also cash paychecks and purchase items in the areas returning revenues to local businesses. Overall effects on the economy are sporadic under this alternative.

Mitigative actions are: continue to employ local firefighters including Los Diablos on a seasonal basis whenever possible; provide options for local merchants to supply goods and services for the fire program

when practical; keep local communities and neighbors notified of park activities to minimize adverse effects.

Cumulative Effects

Cumulative effects outlined at the beginning of the chapter are likely to increase revenues to the local economy independent of fire activities. These effects include the impacts of building trails, constructing housing, a fire office and visitor center at Panther Junction, and increasing visitation as gateway communities grow. Trails provide greater accessibility to more of the park and together with improved visitor amenities are likely to draw more visitors resulting in direct short to long-term beneficial effects on the local economy. Visitors spend money on meals and souvenirs while staying at the park and nearby motels.

Conclusion

Alternative A would result in short-term moderately beneficial impacts from seasonal firefighter employment and high visitor use- the results of a primarily suppression fire policy. Should a high-severity fire occur during extreme weather conditions local merchants and visiting firefighter would receive a one-time windfall. Post-fire economic effects following such a fire are unknown. Visitors may choose to investigate post-fire effects thereby boosting local revenues, or choose another, greener destination. There is sufficient staff within the park to manage the fire program with minimal outside additional support.

Alternative B

Impact Analysis

Alternative B represents a shift from primarily suppression activities under Alternative A to much more fire from lightning ignitions. Additional fires may tax existing staff to meet safety requirements necessitating reallocation of staff duties and/or hiring additional seasonal firefighters to meet high demand periods. Under this scenario, Alternative B would result in direct, short-to long-term beneficial effects to seasonal workers and local merchants. More fire may dissuade visitation (with negative effects on the economy) or encourage visitation (with positive effects on the economy) depending on visitors' perceptions.

Mitigation actions are: similar to Alternative A with greater emphasis on education and interpretation to counter any falling visitor attendance such as Visitor Center information on alternate destinations, closures or cautions; hire additional staff locally if possible.

Cumulative Effects

More fire is allowed in the park under Alternative B potentially straining existing resources during fire season. Other fires on nearby state lands, private holdings and the Mexican preserves may further strain park resources. Regionally more routine fire events would benefit local suppliers of goods and services and provide a pool of expertise, which could serve a number of agencies. These effects would cumulatively result in minor to moderate direct beneficial impacts to local seasonal employees and merchants, with benefits diminishing as fuels are reduced over time.

Conclusion

Alternative B would result in short to long-term beneficial effects by providing income to seasonal firefighters and sales to local merchants as fire frequency increases in the park. Benefits are expected outside fire season for prescribed burns and during fire season for natural ignitions, extending the period of benefits to firefighters and merchants.

Alternative C

Impact Analysis

Alternative C is similar to Alternative B but with more planned prescriptive/research fire events. Conceivably this alternative could provide the most reliable economic benefits to seasonal employees and merchants. The additional tasks and seasonal employment to undertake monitoring and control of more fire events would be expected to provide short- to long-term direct beneficial effects to firefighters and suppliers.

Mitigation actions are the same as for Alternative B.

Cumulative Effects

Cumulative effects would tax already burdened permanent staff. The economic effects of stress are unknown in this scenario. The benefits to seasonal employees, and merchants are likely to be direct, beneficial and minor to moderate over the life of the FMP.

Conclusion

Under Alternative C beneficial impacts to the economy would range from minor to moderate depending on fire frequency, duration, intensity and size, and whether permanent park staff can meet staffing and additional seasonal firefighter needs.

Impact Topic (4): Vegetation

While trained observers pointed to the need for reintroducing fire into Big Bend since the 1940s (McDougal) and 1960s (Leopold), park staff followed the national policy of suppression. Historical vegetation structure has changed from heavy grazing prior to park formation. Extended drought slowed recovery of grasses on limestone allowing woody species to increase (Muldavin et al. 2001). High elevation grasslands appear to have recovered however, but woodland canopy is far greater than that recorded by biological surveyor Vernon Bailey in 1901 (Schmidley 2002). The park began a modest prescribed burn program in 1980s to protect developments. Fuels have continued to increase across the park and in preparing this EA, staff recalibrated vegetation types to reflect fire program concerns. Staff added measures to protect unique habitats, took account of the effects of spreading nonnative plants, and developed a research agenda to better understand ecological processes.

Floodplain and Upland Riparian

Fire effects on species: Table A-1 in Appendix B

Until the formation of the park and frequent visitors, fire was uncommon along the river. Spring floods removed understory, which could act as ladder fuels, from the scattered gallery forests of cottonwood and mesquite. Relative humidity and fuel moisture were high keeping fires small. Frequent human visitation, together with lower river flows and dense stands of saltcedar and giantreed has led to an increase in fires along the river. Saltcedars ability to reestablish rapidly from seed, roots and stem means it will continue to outcompete native species. Bermuda grass and buffelgrass, both exotics are also established along the riparian corridor and form mats of fuel under moist summer growing conditions. Both respond rapidly after fire and can outcompete local natives. Fire is an impediment in this category unless followed up with control measures for saltcedar and the exotic grasses.

Upland springs have had saltcedar removed. The IDT proposes to protect native canopy species from fire if possible, and remove exotics as they appear.

Scrub Desert

Fire effects on species: Table A-2 in Appendix B

Desert scrub is dominated by shrubs (creosote, mariola and ocotillo), and succulents (prickly pear, lechuguilla, and Texas hetchia or falseagave). These shrubs will carry fire under high winds. Grasses are subdominant and provide insufficient fuels to carry fire. Muldavin et al. (2001) in a survey of 77 transects from 1950 to 1996 in the northwest of the park identified soil type, elevation and moisture conditions as determining shrub cover. Greater runoff and erosion and high evaporation during the growing period leads to establishment of deeper-rooted and probably widely-spaced shrubs on drier limestone soils. Recovery of grasses is not expected except during cycles of above average rainfall. Wonzell et al. (1996) show a similar correlation between shrub and grass cover and predominant landforms. Almost half the park is scrub desert, which does burn when canopies are dense, winds high, and plants close enough for fire to carry. Depending on biomass production, fire may occur every 30-250 years (infrequent) (USFS – FEIS site). Staff are establishing research plots to understand if fire can increase tobosagrass and chino grama.

High Desert Grasslands

Fire effects on species: Table A-3 in Appendix B

The largest fires in the park have occurred in this vegetation type (>1,000 acres). The studies above would have predicted post-grazing recovery on igneous, depositional ecotone with low runoff and evaporation during the growing season. Shrubs are still present in these grasslands and fire would shift them towards occupying shallow rocky soils on ridge tops and along drainage bottoms. The IDT know that lightning caused fire is likely to spread uphill into woodlands along drainage bottoms. Control will be extremely difficult because of the high fuel loads under some woodlands and forest. Fire return intervals for desert grasslands may be as frequent as 7-10 years (McPherson 1995). Sexton and Kaufmann estimated up to 20 years for this association (Burns will favor an increase in grasses and containment of shrubs and seedling trees).

Shrub Woodlands

Fire effects on species: Table A-4 in Appendix B

Oaks, acacia, mimosa and sumac all resprout after fire and the small shiny-leaved shrubs reflect fire. The grazing era removed grassy understory, and dense clumps of aloysia persist in former stock corrals. Fire would have thinned shrub densities and killed sapling juniper and pinyon. Because of grazing and suppression there is perhaps more shrub cover than before Europeans, skewing types of habitat (black-capped vireo) and foods available (berries eaten by black bear). Alligator juniper sprouts vigorously from the underground base and the bark protects mature trees from damage. Redberry juniper may reach maturity within 10 years. Prescribed fires at low to moderate intensity are unlikely to be useful in removing current mature junipers but high-intensity fire may remove junipers for up to 50 years. Mexican pinyon is relatively resistant to fire. Moir (1982) counted four fires in a tree ring sample in an 80-year-old tree. Fire return intervals for maintaining open stands of pinyon-juniper are commonly 10-30 years (FEIS web site). Baker and Shinneman (2004) point to the difficulty of lowering P-J densities using low-intensity fire (usually becomes high-intensity) and recommends experimental work on site to determine correct prescriptions.

Grassy Woodlands

Fire effects on species: Table A-5 in Appendix B

This predominately pinyon-juniper-oak vegetation is a fire maintained assemblage. Trees are mature and unlikely to be seriously impacted by low-intensity fire. However, fuel levels are moderate to high and canopies are closing or closed which together could lead to crown fire. More fire will open canopies and increase grasses but a cycle of burn will probably be necessary to achieve the greater grass cover recorded by Vernon Bailey in 1901.

Forest

Fire effects on species: Table A-6 in Appendix B

Moir (1982) found 10 fires between 1770 and 1940 at a range of 9-60 years and estimated fire frequency in this assemblage at 70 years (Moir 1982). Baisan and Swetnam (1995) in averaging results across 63 sites suggested 25 years. The numerous species with differing responses to fire suggest that topography has shaped fire behavior. Redberry juniper can tolerate fires 10-20 years, Pinchot juniper every 30-50 years, and Alligator Juniper 20-30 years. Aspen typically regrows as a clone after a severe fire event. Arizona Cypress is quite intolerant of fire and probably survived due to patchy fire. Oaks typically resprout after fire from the base. Mature ponderosa pine is expected to survive fire. The talus slopes, sheer cliffs and rocky terrain would direct fire so that mosaics of burned and unburned vegetation occur.

The IDT want to retain most mature trees and burn understory fuels and saplings at low intensities.

Assessment Methodology

Impacts of the fire program on vegetation were developed from the experience of park staff, the US Forest Service maintained fire effects web site, and from the literature.

Intensity of effects are defined for vegetation as:

- Negligible:** An action that could affect individuals with no measurable effect on populations or vegetative communities. Impacts would be barely perceptible to landscape features
- Minor:** An action that could cause a change to populations, but the change would be small, and if measurable, would have a small and localized effect and not cause decrease or increase of species diversity in the park. Impacts would remain localized and confined to a single element of significant characteristic of a landscape such as a particular plant community over a small area. Restoration would be relatively easy.
- Moderate:** An action that could cause a change to populations and communities that increase or decreases species diversity in the park. The change would be localized and not considered a threat to the long-term survivability of the species in question. Impacts would be sufficient to cause a noticeable but not substantial change in landscape features such as alteration of a particular plant community in several localized areas. Restoration may be time-consuming, costly, or relatively complex.
- Major:** An action that could decrease the species diversity of the park, be considered a threat to the long-term survivability of populations in question and/or eliminate the population of a species that is locally endemic or considered key to the natural integrity of the park. Impacts would result in substantial and highly noticeable changes in landscape features, such as complete loss of vegetation over a widespread area. Restoration may not be feasible.
- Impairment:** A major, adverse impact to a resource or value whose conservation is (1) necessary to fulfill specific purpose identified in the establishing legislation or proclamation of Big Bend National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents.
- Short-term:** A return to the pre-event range of variability in distribution and abundance of species or arrangement of vegetation on the landscape within the natural fire interval of the affected habitat.

Long-term: Unlikely to return to pre-event range of variability in distribution and abundance of species or arrangement of vegetation on the landscape within the natural fire interval of the affected habitat.

Alternative A

Impact Analysis

Alternative A would continue suppression of most natural ignitions across the park. This would protect unique habitats such as upland springs and dunes, and the floodplain where exotic plant establishment and seed dispersal may be enhanced by fire, favoring more fire tolerant vegetation over time. Excluding fire from mountain meadows, woodlands, and grasslands allows further shrub encroachment and canopy closure, which impacts vegetation structure and species diversity— long-term adverse impacts. The dynamics of fire in these altered environments may be difficult to predict. Fuel buildup in the woodlands and high fuel loads in Chisos forests increase the risk of high-severity, widespread fire to relic and rare systems under extreme conditions during the summer fire season. Wilderness suppression requirements increase the difficulty of controlling fire and create hazards for firefighters and the public. Landscapes and ecological processes may be changed for many decades. Under this alternative effects are likely to be moderate to major, direct, indirect, adverse and long-term.

Prescribed fire with mechanical and manual fuel reduction around developments would result in mortality to a small number of plants. Localized, direct minor effects to plant communities would result from the activities of work crews, such as: laying firelines, burning slash piles, and removing individual trees and shrubs. Burning would release some nutrients to the soil and allow seedling establishment.

Mitigation actions include: locating potential firebreaks, staging camps and spike camps ahead of fire; restore site immediately after fire if needed; restrict prescribed fire to low and moderate intensity; use Minimum Impact Suppression Techniques whenever possible; manage wilderness in accordance with the Wilderness Act including: hand tools rather than mechanized tools and aircraft; no spike camps, crews or other personnel overnight; biodegradable retardant if it must be use; avoid spills, foam or erosion near water.

Cumulative Effects

Cumulative actions which add to proposed actions under the fire program include:

- Large fires on lands adjacent to the park at the same time as fires within the park may create problems for obtaining sufficient resources to manage fire and probably result in continued suppression – an direct, minor to moderate adverse impact.
- Fire events at Big Bend preceding and following the term of the new FMP. High-severity fire may occur leading to loss of mature trees and views.
- Continued fuel accumulations in the Chisos predispose the forests and woodlands to high-severity fire – a moderate adverse direct impact.
- Expansion of nonnative plant species increases the flammability of these sites jeopardizing endangered species and changing fire regimes.
- Pilot revegetation of natives along the riparian corridor will remove saltcedar, a minor to moderate beneficial effect.
- Past and future flood and erosion events would reduce seedling in low desert areas (erosion) but high rainfall may increase recruitment of seedlings elsewhere – minor long-term beneficial effects.
- Defoliation of trees by caterpillars in the Chisos during periods of stress is an adverse effect creating more fuels. Prescribed burns that remove fuels provides minor to moderate beneficial effects to mature trees.

- Expanded interpretive and education programs may lead to minor beneficial effects as the public develop understanding of fire's role in the landscape.

Conclusion

Actions under Alternative A limiting the spread of exotic species and preventing the loss of valued habitats through suppression provides beneficial direct short-term impacts. Restrictive initial decision criteria that determine whether fires are allowed to burn have curtailed the use of natural ignitions allowing fuels to build up and preventing fire in fire-adapted systems. High severity fire in the Chisos leads to moderate to major adverse impacts over the short-term. Long-term the effects are unknown.

Under Alternative A, there would be no impairment of the park's vegetation because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Big Bend National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents.

Alternative B

Impact Analysis

The goal of Alternative B is to attempt to quickly reduce fuels across the park and avert a high severity event. Decision criteria on ignitions are flexible and prescriptions maintain safety by only allowing fires to burn at low to moderate intensities. Under this alternative, there is confidence that burning even if the fire frequency and effects of fire are unknown will benefit park ecosystems in the long-term. Fuels would be reduced, plant communities regenerated, and a natural fire regime returned to the park. More frequent disturbance, however, could predispose sites to invasion by exotic species changing flammability and species composition over time. More fire tolerant saltcedar is displacing cottonwood and willow along the riparian corridor. Buffelgrass, Bermuda grass and giantreed predispose the floodplain to more and hotter fires. Without control of exotic species following fire there would be long-term direct minor to moderate adverse effects as vegetation composition shifts to more fire tolerant species. More frequent fire could maintain high desert grasslands by increasing species diversity, reverse shrub encroachment in meadows, remove saplings and water competition among oak, pinyon-juniper woodlands, remove ladder fuels and duff in forests, and through creation of low fuel buffer areas provide greater protection for legally protected species and cultural resources. These impacts are expected to be direct moderately beneficial and long-term.

Prescribed fire with mechanical and manual fuel reduction around developments would result in mortality to a small number of plants. Localized, direct minor effects to plant communities would result from the activities of work crews, such as: laying firelines, burning slash piles, and removing individual trees and shrubs. Burning would release some nutrients to the soil and allow seedling establishment.

Mitigation actions in addition to those under Alternative A include: flexible boundary agreements with neighbors would allow fire to be controlled at natural barriers reducing the effects of control and suppression activities on vegetation.

Cumulative Effects

Similar to Alternative A; agreements with neighbors may lead to minor short-term, direct beneficial effects for vegetation.

Conclusion

Minor adverse short-term impacts from fire with moderately long-term beneficial effects to vegetation communities and fuel levels as natural fire regimes are restored. Applying mitigation measures to burned areas of exotics provides short-term beneficial effects.

Under Alternative B, there would be no impairment of the park's vegetation because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Big Bend National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents.

Alternative C

Impact Analysis

Under Alternative C prescribed fires and mechanical and manual fuel reduction around developments would result in mortality to a small number of plants as for the other alternatives. Like Alternative B, more natural and prescribed fire would be allowed in the rest of the park with similar effects to fire-tolerant habitats and areas of exotics. Alternative C adds research burns to identify fire-effects to Chisos forests and woodlands, to better understand restoration of grasslands, enhance habitat of threatened species where possible, assist in the protection of cultural resources, and aid restoration of riparian areas. Observing fire dynamics under low and moderate intensity burns coupled with careful pre-fire and post-fire monitoring would aid reintroduction of fire where the fire regime is not well documented. Using research burns is expected to lower any unknown but potentially adverse effects from allowing prescribed and natural ignitions where suppression has been the norm or where fire frequency is unknown. Fire would be gradually reintroduced with the effects leading to direct beneficial, long-term benefits to vegetation. An adverse indirect effect is the time required until effects are understood and applied. A high-severity, widespread fire could occur in the Chisos before research is completed and implemented into fire operations.

Mitigation actions are the same as Alternative B.

Cumulative Effects

Cumulative effects are the same as Alternative B.

Conclusion

Short-term adverse minor to moderate impacts are expected from vegetation loss with direct long-term beneficial effects to plant communities.

Under Alternative C, there would be no impairment of the park's vegetation because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Big Bend National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impact Topic (5): Threatened & Endangered Species

Protecting federally listed species require careful precautions to safeguard individuals, populations, and their habitats over the long-term.

Wildlife

The park supports many animal species, but staff considered only those that for reasons of population size, federal protection, or limited habitat, needed special consideration in this EA. Potential fire effects

were initially investigated for 11 federally protected animals listed in Table III-1 and sensitive species listed under this topic in Chapter III. The endangered Mexican long-nosed bat (*Leptonycteris nivalis*), and endangered black-capped vireo (*Vireo atricapilla*) were formally evaluated for potential effects under the three fire alternatives. The effects of the FMP on these two species is being evaluated under a Biological Assessment (BA).

Fire is known to cause direct injury and death to animals caught in its path (Howard, Fenner and Childs 1959). Effects depend on the size, intensity, and speed of fire, and the speed and mobility of the animal. Mountain lion, deer, and bear without young could be expected to flee an advancing fire front but small animals may be unable to escape. Snakes, lizards, rodents and amphibians living underground can survive intense fire insulated by earth (Lyons et al. 2000). The Texas horned lizard survives wind driven fire in desert scrub because carrier fuels are discontinuous providing avenues for escape. Birds and bats are highly mobile and unlikely to be adversely affected by fire directly if it occurs outside nesting or roosting seasons (Robbins and Myers 1992). While fire may kill some individuals, in general effects on populations are usually negligible (Patton 1992). The Chisos is likely to pose greatest direct effects to small populations of bear and mountain lion with young, and nesting birds during extreme fire conditions.

Indirect effects of fire on habitat have greater effect on populations than individuals (Singer et al. 1989). Effects include migration, predation, starvation or death due to loss of habitat. Fire may kill agaves needed by nectar feeding bats, destroy nesting and fledgling sites for birds, eliminate insect habitat, and expose adults and young to weather extremes. Under the preferred alternative patchy burns during cool seasons outside nesting periods ensures mosaics of unburned habitat remain, reducing browsing pressure and providing alternative cover and food for small mammals, reptiles and birds. Limited food sources following fire may lead to starvation of female bears and migration of males. Raptors however, may be attracted to recently burned areas that expose rodents and other prey. Successional changes from woodland or forest to shrublands or from shrublands to more grasslands will influence wildlife distributions.

Increased sediment loads may occur from erosion following fire. Amphibians and the Texas hornshell could be adversely affected as silt fills seeps and drainages, but agricultural pesticides in low river flows may prove a bigger threat. Fish are affected by changes in physical and chemical qualities of water following fire. Sediment loads increase because of erosion and may kill eggs or fry (Patton 1992). Removal of vegetation along waterways by fire may increase water temperatures leading to changes in species composition and distribution. In general these indirect effects are more important because slow reestablishment delays or may jeopardize recovery of populations.

Plants

Staff evaluated 33 plants for potential effects under the FMP and one species the Chisos Mountain hedgehog cactus is being formally evaluated in a BA by the USFWS.

Plants survive fire by either surviving the direct effects of fire, or surviving post-fire conditions (Whelan 1995). Survival during fire is facilitated by thick bark, suppression of understory limiting ladder fuels, and non-flammable foliage. Root callus, deep underground roots, soil seed reserves, epicormic buds, regeneration of vegetative plant parts, post-fire weather, and triggering of seed capsules by fire or smoke, facilitate regeneration following fire. Staff are most interested in maintaining species diversity, expecting populations of any particular species to be dynamic over time. The fire program is an investigative tool to understand how this may be achieved.

Methodology

Information from the U.S. Fish and Wildlife Service (USFWS) species recovery plans, park monitoring reports, and the experience of researchers and park staff were consulted in understanding how the FMP may affect threatened and endangered species.

Intensity of effects for threatened and endangered species is defined as:

- Negligible:** No federally listed species would be affected or the alternative would affect an individual of a listed species or its critical habitat, but the change would be so small that it would not be of any measurable or perceptible consequence to the protected individual or its population.
- Minor:** An individual(s) of a listed species or its critical habitat may be affected, but the change would be small and would not adversely affect the continued existence of the species or cause the death of any individual of the species.
- Moderate:** An individual or population of a listed species, or its critical habitat would be noticeably affected. The effect would have some long-term consequence to the individual, population, or habitat and would be difficult to mitigate.
- Major:** An individual or population of a listed species, or its critical habitat, would be noticeably affected with long-term, vital consequences to the individual, population, or habitat.
- Impairment:** A major, adverse impact to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Big Bend National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents.
- Short-term:** Recovers in less than one to three years after the fire or other action (depending on the species).
- Long-term:** Takes more than one to three years to recover after the fire or other action (depending on the species).

The Biological Assessment prepared in support of the FMP revision applies USFWS criteria:

No Effect. When a proposed action would not affect a listed species or designated critical habitat.

May affect/not likely to adversely affect: Effects on special status species or designated critical habitat are discountable (i.e. extremely unlikely to occur and not able to be meaningfully measured, detected, or evaluated) or completely beneficial.

May affect/likely to adversely affect: When an adverse effect to a listed species or designated critical habitat may occur as a direct or indirect result of proposed actions and the effect is either not discountable or completely beneficial. Staff of the USFWS review the park's assessment of impacts on threatened and endangered species and in response issues a Biological Opinion identifying agreement or areas requiring modification.

Is likely to jeopardize proposed species/adversely modify proposed critical habitat: The appropriate conclusion when the National Park Service or the U.S. Fish and Wildlife Service identifies situations in which the fire program could jeopardize the continued existence of a proposed species or adversely modify critical habitat to a species within or outside park boundaries. Staff of the USFWS review the park's assessment of impacts on threatened and endangered species and in response issues a Biological Opinion identifying agreement or areas requiring modification.

Alternative A (No Action)

Impact Analysis

Mexican long-nosed bat (*Leptonycteris nivalis*)

Under Alternative A most fires are suppressed protecting the roost and foraging range of the bat but fuels are allowed to buildup across the park and ecosystem processes are interrupted.

Mitigation actions include: assessment of agave populations (the main food of the bat) to ensure 80% of foraging area is present at any time including after fire, maintenance or suppression actions; suppression of all high-intensity fires in the vicinity of foraging areas; careful fuel reduction near the roost entrance; retaining a buffer zone of low fuels around the roost site; no retardant drops where the roost could be impacted; identification of potential fireline and spike camps prior to fires; construction of firelines using minimal impact techniques; and rehabilitation of areas near the roosting site by replanting; handbrushing lines; and, removing trash and preventing erosion. Post-fire monitoring would assess fire effects and plant recovery.

Black-capped vireo (*Vireo atricapillaus*)

Under Alternative A fires have been suppressed, protecting the birds' territories and nesting sites. Vireo habitat may be an artifact of suppression, the shrub understory growing in response to removal of grasses through grazing. No fire in over 100 years makes these canyon drainages very vulnerable to fire from increased fuels.

Mitigation actions include: not burning any areas currently occupied by vireos; assessing current habitat by vireo experts to understand likely responses from fire; identifying where fuel reduction would be beneficial to habitat; identifying other areas in the park with similar vegetation structure that could be occupied; maintaining a ¼ mile buffer from fire; identifying potential firelines and staging camps ahead of fire; following fires with restoration actions such as replanting and brushing handlines and preventing erosion; and, seeking funding for a population dynamics study to understand why vireos are not occupying suitable habitat. Any research fires in nearby areas would be conducted in late fall and winter outside the vireo nesting season.

Chisos Mountain Hedgehog Cactus (*Echinocereus chisoensis* var. *chisoensis*)

This cactus is found primarily on gravelly limestone derived terraces and sloping pediments with sparse associated vegetation of lechuguilla, creosote and dog cholla. Strict decision criteria on ignitions together with few fuels in the cactus habitat have protected current populations from fire.

Mitigation actions include: establishing new populations from plants and seed, removing buffelgrass around populations and individuals, assigning a resource advisor preferably the park botanist to any fire in the area, identifying firelines and staging camps ahead of fires, avoiding retardant drops in the vicinity of the plants, and rehabilitating areas following fire suppression actions such as recontouring soils, repositioning rocks, or restoring drainage lines.

Guadalupe Fescue (*Festuca ligulata*)

Currently the only known populations of this grass are in the Chisos Mountains of Big Bend National Park and the Sierra del Carmen in Mexico. A small population of about 500 plants occurs on shaded moist slopes in Boot Canyon, and is managed under a Candidate Conservation Agreement with the Austin Texas Ecological Services of USFWS signed by the park on 9 April 1998. It is not known whether fire would potentially benefit this species. Park botanist Joe Sirotnak is currently evaluating the plants' lifecycle and requirements for reproduction. Seed set is prolific but establishment is extremely low perhaps due to high duff levels. Fire is one research approach being considered for very small areas to

test seedling establishment in mineral soils. A determination is not made for candidate species. The park will continue to coordinate with the USFWS before burns take place that may affect this species.

Under Alternative A, duff levels will continue to increase and possibly interfere with seedling establishment.

Southwestern Willow Flycatcher (*Empidonax trailii extimus*)

Southwestern willow flycatcher prefers thick streamside vegetation, and its rarity is a consequence of the loss of such habitat in the Southwest. In addition to habitat destruction by humans, cowbird parasitism, predation, and negative effects of recreation and research activities are all cited as threats (New Mexico Game and Fish Department 2000) leading to federal listing as endangered on September 1992 (57 FR 39664). Information on flycatcher use of the lower Rio Grande is anecdotal. The flycatcher has been recorded as nesting in the middle and lower stretches of the Rio Grande River in saltcedar (Mark Sogge, personal communication, March 2004). Since 1990, Kelly Bryant working on state lands throughout the southwest has observed the flycatchers during migration in the lower Rio Grande but has not found evidence of them nesting along the river (Personal communication, March 2004). Mark Flippo, park biologist at Big Bend confirmed Bryant's observations (March 2004). If the flycatcher nests in the riparian corridor it would be present from mid-May through September.

Fire may be a component of pilot programs in 2006 testing methods to restore sections of native riparian vegetation along the 118 miles of Rio Grande inside the park border (Joe Sirotnak, personal communication, January 2004). These small sections would be surveyed prior to any disturbance in the area. The susceptibility of the flycatcher to fire effects is slight given the bird's rarity in this region, and the extensive areas of riparian vegetation in the park, and the commitment to suppression along park borders. Because of the rarity of flycatcher sightings, a "may affect- not likely to adversely affect" determination is made for this species.

Alternative A ensures suppression of fires along the riparian border with Mexico but suppression efforts may damage vegetation.

Northern Aplomado Falcon (*Falco femoralis septentrionalis*)

This medium-sized falcon was once found throughout southeast Arizona, southern New Mexico, West Texas and much of Mexico. Generally they inhabit open grasslands with scattered trees and relatively low ground cover, needing a supply of suitable nesting platforms and an abundance of small to medium-sized birds as prey. The park's grasslands have probably changed dramatically since the 1880s and what may have been ideal habitat has been greatly diminished. Aplomados have been reestablished at Marfa, 100 miles northwest of the park but none have been sighted in the park. The preferred alternative may improve habitat conditions for Aplomados and attract them to the park in the future. The determination for this species is "no effect."

Under Alternative A, suppression allows continued shrub encroachment into grasslands dissuading return of this species.

Big Bend Gambusia (*Gambusia gaigei*)

The greatest dangers to fish numbers come from competition with Western mosquitofish and the introduced Green Sunfish, which probably arrived through dumping of excess bait into the ponds. Fire program threats include petroleum from vehicles leaking into the ponds and changes in pH from fire ash. A prescribed burn close to the ponds in February 2003 dumped high levels of ash without ill-effect to the fish suggesting that the change in pH was either not large or not of sufficient duration to cause harm (Raymond Skiles, Personal communication, February, 2004). A nearby bridge made from recycled plastic may pose problems if it burns and smoldering residues drop into the water. The ponds have been protected from runoff and petroleum leaks by large earthen berms. Future prescribed burns would protect

mature cottonwoods and remove some vegetation reducing the intensity of the burn. Burns would create a mosaic to ensure some shading and protection from predators. Research burns that reduce fuels may improve spring flows increasing volume and improving water quality. A “may affect-is not likely to adversely affect” determination is made for this species under the proposed fire alternative.

Without fuel reduction measures there is the risk of fire around the ponds particularly as they are near a well-used camping area. Suppression under Alternative A would continue to increase fuels leading to higher risk prescribed burns.

Bunched Cory Cactus (*Coryphantha ramillosa*)

This cactus occurs on the limestone of the Boquillas and Santa Elena formations with creosote and lechuguilla. The plant is also found in Terrell County, Texas and the state of Chihuahua in Mexico. Park staff are currently mapping all known locations of this species and will continue to update GIS databases of rare, endemic, and listed plants (Alex, 2003). Researchers Kathy Rice, Ted Anderson and Robert Schmalze at the Desert Botanical Gardens in Phoenix have been analyzing the reproductive characteristics, microhabitat, and associated vegetation of this cactus (1 April, 2004). The proposed alternative for the FMP is unlikely to cause adverse impacts on known populations in the absence of grasses and other vegetation to carry fire. The determination for this species under the preferred alternative is “may affect – not likely to adversely affect.”

While suppression under Alternative A protects current populations, the suppression activities may inadvertently damage plants.

Lloyd’s Mariposa Cactus (*Sclerocactus mariposensis*)

Named for the Mariposa Mine in Southern Brewster County where it was first discovered, this cactus occurs on rocky, gravelly soils primarily derived from limestone. It is an attractive, rounded plant to four inches with pale star-shaped spines and pink, green or tan flowers in February through March, with fruiting from April through May. This cactus was listed as threatened in 1979 because of over-collecting. A recovery plan was developed in 1992 by the U.S.FWS. Park staff estimate there are many hundreds of individuals on about 30 sites primarily in the Eastern side of the park and the Black Gap Wildlife Management Area at elevations of 2,600-4,600 feet. Associated vegetation includes sparse creosote, lechuguilla, candelilla, leather stem, and other cacti. It is unlikely that fire will have an adverse impact on the park populations as fuels are sparse and discontinuous. Therefore the park makes a determination of “may affect- not likely to adversely affect” for the proposed fire program.

While suppression under Alternative A protects current populations, the suppression activities may inadvertently damage plants.

Hinckley’s Oak (*Quercus hinkleyii*)

This oak is unlikely to occur in the park as the extremely distinctive foliage is difficult to miss.

Mitigative actions are: following USFWS Recovery Plans for listed species; ensuring resource experts are consulted during fire operations; preemptive plans are in place before fires to minimize damage; non-fire fuel reduction or prescribed burns are used to protect habitat; post-fire monitoring is used to improve prescriptions.

Cumulative Effects

Cumulative effects include

- Development of walking trails in the Chisos and along the river may increase disruption to established wildlife use patterns – a minor adverse effect.
- Large fires on state and private lands adjacent to the park may jeopardize recolonization of animals (e.g. bear) and plants if the park has losses after fire.

- High-severity fire could occur before the outcomes of the preferred alternative take effect – a minor to moderate direct adverse effect.
- Continued fuel accumulations in the Chisos increase the likelihood of high-severity fire and the loss of rare plants and animal habitat – direct, adverse minor to moderate effects.
- Expansion of nonnative plant species increases the intensity of fire – a direct adverse minor effect.
- Pilot revegetation of natives along riparian corridor could be minor direct beneficial effect.
- The effect of past and future flood and erosion events are difficult to ascertain.
- Defoliation of trees by caterpillars in the Chisos during periods of stress increases woody fuels and fires burn hotter – a minor to moderate direct adverse effect.
- Expanded interpretive and education programs may increase public support for fire operations that reduce fuel loads and protect habitat - a minor to moderate direct beneficial effect.

Conclusion

In the short-term, effects to listed plant and animal species are minimized by suppression. The likelihood of adverse affects increases with time as fuels build and fires are likely to be more widespread and burn hotter. Removal of habitat is likely to cause greater loss than direct impacts of fire to animal species.

Under Alternative A, there would be no impairment of the park’s protected species whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Big Bend National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park’s general management plan or other relevant NPS planning documents.

Alternative B

Impact Analysis

Mexican long-nosed bat (*Leptonycteris nivalis*)

More natural and prescribed fire is proposed under Alternative B outside the bats seasonal stays from mid May to late July in the park. Alternative B provides the option of prescribed burns to lower fuels if deemed necessary.

Mitigation actions are the same as the No Action Alternative.

Black-capped vireo (*Vireo atricapillaus*)

Under Alternative B, more low and medium intensity natural and prescribed fire will be allowed in the park to reduce fuels and quickly allow fire to resume its role in the landscape. Vireo experts met in the park in June-July 2004 to identify the best strategies for the bird’s protection. A mix of non-fire treatments, prescribed burns, monitoring and research was proposed.

Mitigation actions are the same as the No Action Alternative.

Chisos Mountain Hedgehog Cactus (*Echinocereus chisoensis* var. *chisoensis*)

Under Alternative B, more natural ignitions will be allowed to burn across the park under flexible criteria governing decisions on fire. Prescriptions are broad to allow natural fires to burn at low to moderate intensity. While fires are allowed under these Alternatives, fires in cactus habitat have been uncommon due to sparse, discontinuous fine understory fuels. However, movement of buffelgrass into nearby arroyos and around some populations increases fuels, flammability and the potential for injury from fire.

Mitigation actions are the same as the No Action Alternative.

Guadalupe Fescue (*Festuca ligulata*)

Under Alternative B fire may sweep through the entire population with unknown consequences.

Southwestern Willow Flycatcher (*Empidonax trailii extimus*)

Under Alternative B, the use of agreements with neighbors could lead to larger burn areas as fires are allowed to burn to natural barriers such as the river, roads or canyon walls. The trade off is maintaining potential habitat versus safety and firefighting effectiveness.

Northern Aplomado Falcon (*Falco femoralis septentrionalis*)

Alternatives B both allow more fire across the park with potentially beneficial effects on grasses and prey for this species.

Big Bend Gambusia (*Gambusia gaigei*)

Decades of suppression and abundant vegetative growth fed by springs have led to accumulations of fuels in some area around the ponds. Prescribed burns around the ponds in 2003 to reduce fuels were difficult to control. Other non-fire thinning and mechanical reduction followed by burning of slash piles may be one way to reduce risks associated with burning. Some fuel reduction is planned to lower hazards in nearby campgrounds.

Bunched Cory Cactus (*Coryphantha ramillosa*)

Alternatives B allow more fire across the park. Low discontinuous fuels on limestone reduce the likelihood of intense or widespread fire under either alternative.

Lloyd's Mariposa Cactus (*Sclerocactus mariposensis*)

Alternative B would allow natural fires to burn. However, fires are uncommon because fine fuels that facilitate the spread of fire are low and discontinuous.

Hinckley's Oak (*Quercus hinkleyii*)

Same as Alternative A.

Cumulative Effects

Cumulative effects are the same as the No Action Alternative.

Conclusion

Allowing more low and moderate intensity wildland fire and additional prescribed burns lessens fuels and the likelihood of adverse effects to plant and animal species and habitat from high-severity fire. These are indirect long-term minor to moderate and beneficial.

Under Alternative B, there would be no impairment of the park's protected species whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Big Bend National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents.

Alternative C

Impact Analysis

Mexican long-nosed bat (*Leptonycteris nivalis*)

Alternative C allows for prescribed burns to reduce fuels and provides the option of research burns to improve foraging habitat if deemed necessary. This Alternative is the preferred scenario as fuels and plant populations are assessed before any decision to conduct prescribed or research burns, fires would be reintroduced carefully to minimize agave mortality, and a natural fire dynamic gradually restored.

Mitigation actions are the same as the No Action Alternative.

Black-capped vireo (*Vireo atricapillaus*)

Under Alternative C, the preferred Alternative, more natural fire and prescribed fire will be allowed in the park as for Alternative B. However, fire will be allowed into areas based on the results of research burns that identify fire effects and dynamics and answer management questions.

Mitigation actions are the same as the No Action Alternative.

Chisos Mountain Hedgehog Cactus (*Echinocereus chisoensis* var. *chisoensis*)

Under Alternatives B and C more natural ignitions will be allowed to burn across the park under flexible criteria governing decisions on fire. Prescriptions are broad to allow natural fires to burn at low to moderate intensities. While fires are allowed under these alternatives, fires in cactus habitat have been uncommon due to sparse, discontinuous fine understory fuels. Movement of buffelgrass into nearby arroyos and around some cactus populations however, increases fuels, flammability and the potential for injury from fire.

Mitigation actions are the same as the No Action Alternative.

Guadalupe Fescue (*Festuca ligulata*)

Under Alternative A, duff levels will continue to increase and possibly interfere with seedling establishment. Under Alternative B fire may sweep through the population with unknown consequences. Under the preferred alternative, Alternative C, a small research burn may be considered to identify germination and establishment rates as most grasses evolved in association with fire.

Southwestern Willow Flycatcher (*Empidonax trailii extimus*)

Under Alternative C the use of agreements with neighbors could lead to larger burn areas as fires are allowed to burn to natural barriers such as the river, roads or canyon walls. The tradeoff is loss of potential habitat versus safety and firefighting effectiveness.

Northern Aplomado Falcon (*Falco femoralis septentrionalis*)

Both Alternatives B and C allow more fire across the park with potentially beneficial effects on grasses and prey for this species.

Big Bend Gambusia (*Gambusia gaigei*)

Decades of suppression and abundant vegetative growth fed by springs have led to accumulations of fuels in some areas around the ponds. Prescribed burns under Alternative A in 2003 around the ponds reduced fuels but proved difficult to control. The ponds proximity to a high-use camping area maintains the risk of fire from carelessness. Alternatives B and C allow more fire across the park reducing fuel levels including the nearby campsite.

Bunched Cory Cactus (*Coryphantha ramillosa*)

Alternative C is the same as Alternative B.

Lloyd's Mariposa Cactus (*Sclerocactus mariposensis*)

Alternative C is the same as Alternative B.

Hinckley's Oak (*Quercus hinkleyii*)

It is unlikely that the oak is present in the park as it has extremely distinctive foliage but has not been found.

Cumulative Effects

Cumulative effects are the same as the No Action Alternative.

Conclusion

Reduction of fuels across the park reduces fire intensity – a direct minor beneficial effect. Applying research results to manage habitats of protected species is a long-term direct beneficial effect.

Under Alternative C, there would be no impairment of the park's protected species whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Big Bend National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impact Topic (6): Cultural Resources

Fire may help reduce hazard fuels, maintain historic views and ethnographic resources, but can also remove plant populations that are important as ethnographic resources, damage and destroy structures and artifacts, and cause adverse changes to significant vegetative components of cultural landscapes.

The rich cultural history of Big Bend National Park is contained in the archeological record and in numerous historic buildings, sites, and settlements. The park as a whole is itself a complex cultural landscape characterized by visible effect of human influence on the natural environment as reflected in communities, small farming settlements, ranch sites, over 450 individual buildings and ruins, extensive farmlands with vernacular irrigation features, and a widespread network of roads and trails. The four main resource types include historic structures, cultural landscapes, archeological resources and ethnographic resources. Fire and fire management activities affects these types of cultural resources very differently.

Greatest damage can occur to historic buildings containing combustible materials. Under extreme fire temperatures, metals and glass melt, ceramics crack and vitrify. Structural integrity of these artifacts is impaired at 232 C and at higher temperatures pollens and other woody materials (which enable dating) are consumed or transformed (Jones, 2002). At temperatures greater than 135 C solder joints in metal cans melt and mortar joints in masonry walls begins to spall. These sites are also damaged by smoke, suppression activities and post-fire erosion, and damage to buildings jeopardizes National Register standing. The fire program sought specific guidelines from the staff cultural resource specialist (CRS) to reduce risk to this group of cultural resources.

The most important consideration in planning fire activities is that of protecting archeological context. The significance of sites, site features, and artifacts is in the degree of integrity of archeological context. Any activity that dislodges features or artifacts from their original location and context changes the scientific interpretation of the site. Any activity that alters the original condition of the site or the cultural materials within it potentially reduces the scientific values which qualify the site for the National Register. Prehistoric archeological sites are presumed to have burned occasionally. Studies in New Mexico show that damage can occur as deep as 20cm into the soil and substantial damage at all fire intensities (Lentz et al. 1996). Fire that burns woody stems of plants growing in prehistoric hearths introduces new carbon into the feature as the plant base decays and debris falls into the depths of the feature, which potentially contaminates radiocarbon dating of the feature. Reducing flammable brush can contain risks from fire, but the removal of the vegetative cover from a site exposes site features and the increased visibility increases the potential of damage from vandalism and theft. Managers must weigh these advantages and disadvantages during fire planning. Archeological identification surveying prior to prescribed burns will slowly identify additional sites within the park.

Vegetation that covers sites and cultural landscapes can screen these sites from view and protect them from the erosive force of rain and sun. An important character defining component of cultural landscapes are the historic plantings placed there by the site occupants. It is important to exclude these vegetative components from damage or loss from either wildland fire or prescribed burning activities. Plants can also

undermine building foundations, and alter historically used springs. Water erosion and fire suppression activities place cultural landscapes at risk.

Ethnographic resources include plants, animals, landscapes or sites that held significance for American Indians. Whether the maintenance of these resources depended upon the deliberate use of fire is unclear but Cabeza de Vaca noted in 1528, that Indians use fire sticks to ignite plains and timber to drive out game (in Kozlwoski and Ahlgren 1974:392). Indiscriminant removal of or alteration of plants from a traditional gathering site must be avoided during prescribed fire planning.

Assessment Methodology

Information in this section was developed primarily from the detailed analysis of cultural resources listed as Appendix 11, from the draft GMP (2003), technical literature, and staff at the park. Cultural resources in the park occur in all of the FMUs. The treatment of the cultural resource is determined by the nature of the resource and not by the FMU. Consequently, suggested treatments in Appendix 11 are grouped primarily according to resource type.

Intensity of effects for cultural resources is defined as:

- Negligible:** Effects are at their lowest level. There are no perceptible consequences to archeological sites, historic structures or cultural landscapes.
- Minor:** Adverse effects would be confined to a small area with little loss of important archeological information; non-measurable loss of defining characteristics of historic buildings or cultural landscapes. Beneficial impacts include stabilization of sites.
- Moderate:** Adverse effects would be disturbance to a site without loss of important archeological information or character defining features of historic structures or landscapes. These would still be eligible for the National Register. Beneficial impacts include stabilization of a site or rehabilitation of a landscape while preserving its character-defining features.
- Major:** Adverse effects include disturbance of a site so that much of the important information is lost, the integrity of buildings or cultural landscapes are damaged and the site no longer fulfills requirements for National Register status. Major beneficial actions include the intention to preserve a site and restoration of a building following Secretary of the Interior's Guidelines for Treatment of Historic Properties.
- Impairment:** A major, adverse effect to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Big Bend National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impact Duration Definitions:

Duration of impacts to cultural resources is not usually considered under the National Historical Preservation Act. Direct impacts are usually adverse and permanent. Landscapes may recover and even benefit from fire and fuel reduction.

Alternative A

Impact Analysis

Under Alternative A, a prescribed burning and fuels reduction program has been developed over the past 20 years to protect developments. Cultural resources have yet to be included under this regime because of limited resources and lack of understanding about how to use the program for best results. The park is currently assessing fuels around particular types of resources, historic buildings, cultural landscapes, ethnographic resources, and archeological sites. There are no blanket prescriptions because all types of resources are found throughout the park in differing types of vegetation and subject to differing risks from fire. Therefore, fire treatment is site-specific and must be tailored to the nature of each individual site. Wherever possible general prescriptions are developed to treat the different resource types and those resources on the Register of National Historic Historic Places. Overall, strict criteria governing fire in the park has likely protected many structures but fuels continue to build up (particularly in the Chisos), which increases flammability and fire temperatures.

Estimates of possible cultural resource sites in the park exceed 26,000, which make accurate estimates of impacts difficult without surveys. The most important consideration in planning fire activities is that of protecting archeological context. The significance of sites, site features, and artifacts is in the degree of integrity of archeological context. Any activity that dislodges features or artifacts from their original location and context changes the scientific interpretation of the site. Any activity that alters the original condition of the site or the cultural materials within it potentially reduces the scientific values which qualify the site for the National Register. Firelines and spike camps placed under emergency conditions may result in direct, adverse long-term impacts such as displacing artifacts from their original archeological context, and damage from crushing, spalling, cracking or consumption of materials.

Mitigation actions are: locate and identify sites vulnerable to fire effect; manually or mechanically reduce fuels; construct fire breaks around registered sites; use minimum impact techniques; ensure an archeologist or similarly qualified resources person is consulted during fires.

Cumulative Effects

Cumulative effects include:

- Construction of building and trails could have minor adverse effects minimized by surveys.
- Past and future prescribed burns, wildland fire use and non-fire fuel treatments may have adverse minor impacts, minimized by surveys and use of resource experts.
- Continued fuel accumulations in the Chisos, and expansion of exotic plants may lead to hotter burns and cause minor adverse effects.
- Revegetation of natives may reduce fuels leading to minor beneficial effects.
- Past and future flood and erosion events may have moderate to major adverse impacts.
- Expanded interpretive and education programs may lead to minor beneficial effects.
- Ground disturbance during suppression and hotter fires would result in minor direct and indirect adverse effects. Under Alternative A (No Action), cumulative impacts could be more intense because of the increased potential for high-severity fires.

Conclusion

Under Alternative A, minor to moderate beneficial impacts are likely to known sites. Impacts are likely to be localized and long-term. Under Alternative A, there would be no impairment of the park's cultural resources because there would be no major adverse impacts to *known* resources whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Big Bend National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents.

Alternative B

Impact Analysis

Allowing more prescribed and natural fire across the park increases the opportunity for fire to damage known sites and for undocumented sites to be damaged by fire control activities. Reducing fuels throughout the park is likely to result in minor to moderate direct beneficial effects for cultural resources over the short-term. The length of benefits depends on frequency of burns, their intensity, and control methods. Unknown archeological sites are at moderate adverse risks from suppression activities.

Mitigation actions are the same as Alternative A with the addition of allowing fire to burn to natural barriers along the park border. Allowing fire to extinguish naturally would reduce damage from suppression.

Cumulative Effects

Cumululative effects would initially be the same as Alternative A until fuels are reduced in the Chisos.

Conclusion

Alternative B is likely to result in long-term beneficial effects as fuels are reduced across the park and treatments of specific sites are implemented. Effects on unknown sites cannot be easily ascertained but prehistoric sites that have burned previously likely will not be damaged further. Greatest risks are from suppression activities.

Under Alternative B, there would be no impairment of the park's cultural resources because there would be no major adverse impacts to *known* resources whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Big Bend National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents.

Alternative C

Impact Analysis

Under Alternative C, developed areas remain protected through prescribed burning and no-fire treatments, and an expanded monitoring program builds knowledge of fire effects. More fires will be allowed to burn elsewhere in the park under prescriptions and may cause minor direct adverse effects over the short-term as archeological sites are blackened and exposed. Like Alternative B, suppression and control activities could inadvertently cause adverse effect to unknown prehistoric archeological sites. Increased burns using low intensity fire treatment will reduce fuel levels leading to lower levels of risk to cultural resources from high-intensity fires.

Mitigation actions are the same as Alternative A with the inclusion of more sites found through surveys associated with increased prescribed burns and monitoring.

Cumulative Effects

Cumulative effects are similar to Alternative A. Adverse impacts from increased prescribed burning could be greater unless accompanied by surveys and minimum impact suppression techniques.

Conclusion

Implementing mitigative measures in conjunction with increased fire use in the park would keep minor adverse long-term impacts to a minimum.

Under Alternative C, there would be no impairment of the park's cultural resources because there would be no major adverse impacts to *known* resources whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Big Bend National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impact Topic (7): Watershed Effects

Fire can remove vegetation and organic matter, and followed by intense thunderstorms lead to loss of rare plant and animal species through erosion, debris flows, and siltation, the demise of relict forests, invasion by weed species, loss of wildlife habitat, and substantial long-term changes in the vegetation.

The Chisos Mountains are a premier destination for visitors to Big Bend. Camping in the mountains is the most popular recreational activity (GMP 2003), and one the park wants to maintain. The sparsely vegetated lowland desert grasslands are a sharp contrast to the mountains and a reminder of the predominant climate throughout this region. Staff believe the region is significantly altered since grazing but some areas may have the potential to be restored, which would represent a significant scientific contribution to desert grassland restoration.

Post-fire impacts on watersheds are influenced by many factors. Fire intensity, rainfall intensity and amount, slope, soil texture, water depth and holding capacity, rock fractures and outcrops, and amount of vegetation and charred material will affect infiltration, runoff, and potential erosion. Vegetation removed by fire is no longer available to break the erosive impact of rain, nor utilize water that infiltrates soils. Severe fires burn the tree canopy and soil seedbeds, and invasive plants better adapted to drier soils may colonize exposed sites. During fire, soil surface temperatures are high and dry out, which makes them initially hydrophobic and prone to runoff. Other effects are the release of nitrogen upon burning and stimulation of microbial activity upon exposure of soils to higher temperatures and oxygen. Post-fire temperatures of soil are elevated and may aid seedling germination with sufficient moisture (Scifres and Hamilton 1993). Erosion becomes a threat immediately following fire as intense thunderstorms may dislodge soil particles on bare steep slopes, which carries them into drainage lines and silting areas below. These flows could be short-lived but overwhelm seasonal drainages where mesic plant and amphibians live. Recovery may also be jeopardized by the changes in nutrient levels and pH within shallow ponds that become silted. The amount of erosion is influenced by rainfall intensity, permeability of the soil, and amount of vegetation, cobbles or rock on the surface. The intense summer rainfall is absorbed more readily by sandy, gravelly, and loamy soils than by fine-textured clays and silts, found in flatter areas and in depressions.

Assessment Methodology

Staff estimated likely impacts of erosion and debris flows on 11 watersheds with 6 major soil map units in the Chisos Mountains. The estimate of effects was based on soil type, slope, and rainfall conditions following a (1) high severity, widespread fire that could occur without fuels reduction, and (2) a moderate intensity fire, which is the upper limit of allowed fire conditions under the preferred alternative. Park hydrologist Jeffrey Bennett and soil scientist Lynn Loomis (USDA/NRCD Marfa, January-May 2004), provided guidance for this watershed evaluations.

Intensity of effects for watersheds is defined as:

- Negligible: No runoff, debris flows, or perceptible effects on soils.
- Minor: Perceptible but hardly measurable effects on soils or debris flow. Effects easily restored.
- Moderate: Measurable and noticeable effects. Runoff causes erosion. Debris flows silt drainages and ponds. Restoration work required to prevent downcutting and siltation of drainages.
- Major: Erosion is apparent and cannot be remedied easily. Debris flows have silted low lying areas. Soils and organic matter layer are removed. Restoration is extensive.
- Impairment: A major, adverse impact to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Big Bend National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents.
- Short-term: For the duration of the fire season.
- Long-term: For the duration of the fire program or longer.

Alternative A

Impact analysis

Under Alternative A, restrictive go/no-go decision criteria mean most lightning ignitions are suppressed. The probability of widespread, high-intensity fire in woodlands and forests of the Chisos Mountains increases with the buildup of leaf and needle litter, downfall, ladder fuels and the closure of tree canopies. A high-severity, high-intensity fire would result in long-term, moderate to major adverse impacts on watersheds. The intensity and duration of rainfall, coupled with soil texture and depth, slope, rock fractures and outcrops would determine erosion and debris flows following fire. Intense thunderstorms may silt drainages containing rare species. Sparse vegetation in the lowland deserts means most fire is driven by high winds and results in a mosaic of burned and unburned areas.

Mitigation actions are: prescribed low-intensity burns in the Chisos; identifying firebreaks, staging camps and spike camps ahead of fires to minimize ground disturbance from suppression activities; uppressing fire in Upper Pine Canyon, a Research Natural Area, where fire would interrupt long-term ecological studies. There are few options for reintroducing fire due to restrictive decision criteria on natural ignitions and treatment of the Chisos as a suppression zone. Staff have been reluctant to explore grassland restoration in lowland deserts without a clear research agenda.

Cumulative Effects

Cumulative effects that would increase adverse effects in the Chisos are the construction of additional hiking trails, and continuing buildup of fuels. No action in the lowland deserts may result in continual erosion, the rate dependent on precipitation, climatic cycles, and periodic thunderstorm events. Under Alternative A, cumulative impacts could be more intense in the Chisos because of the increased potential for high-severity fires.

Conclusion

Fire management suppression impacts to watersheds in the Chisos are likely to be adverse, minor to moderate and long-term while suppression continues, fuels build, and the potential for high-severity fire increases. The potential continues for moderate, adverse impacts to soil stability and debris flows following high-severity fire and summer monsoons. While suppression remains successful impairment is unlikely. Minor, adverse impacts are expected to watersheds in lowland deserts without restoration efforts.

Under Alternative A, because there would be no major adverse impacts to watersheds whose conservation is (1) necessary to the establishing legislation or proclamation of Big Bend National Park; or (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning document.

Alternative B

Impact Analysis

Under Alternative B, natural and prescribed fires are allowed to burn under prescription across the entire park up to buffered areas around developments. This alternative proposes rapid reintroduction of fire to park ecosystems to reduce high fuel loads in the Chisos woodlands and forests. This would also regenerate plant communities where fire occurred naturally. The prescriptions ensure that initially burns are low- to moderate-intensity until fire effects are understood. Staff would review of fire effects annually and adjust intensity and season to allow more lightning ignitions just prior and during summer monsoon when most fire historically occurred.

Impacts are expected to be short- to long-term and minor to moderately beneficial in reducing fuels and regenerating plant communities. There may also be short- to long-term minor to moderate adverse effects to views and soils in the Chisos as vegetation reestablishes.

Mitigation actions are similar to Alternative A with the addition of post-fire monitoring of prescribed and natural ignitions, and annual review of prescribed burns and fine-tuning of prescriptions.

Cumulative Effects

Alternative B would have fewer adverse long-term effects than Alternative A. Allowing fire in the Chisos at low and moderate intensities should lessen cumulative effects of fuels on the likelihood of high-severity fire.

Conclusion

Under Alternative B adverse impacts to the Chisos Mountain watersheds would be minor to moderate and short-term. Minor adverse impacts from fire are likely in lowland desert areas. Beneficial impacts are expected over the long-term for watersheds in the Chisos. Extreme fire events outside prescription before fuels can be reduced would create moderate to major direct adverse impacts over the short and long-term.

Under Alternative B, because there would be no major adverse impacts to watersheds whose conservation is (1) necessary to the establishing legislation or proclamation of Big Bend National Park; or (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning document.

Alternative C

Impact Analysis

The Zone of Special Treatment under Alternative C calls for research fires and careful management of lightning ignitions within prescriptions. Research results potentially allow fires to be managed in

sensitive habitats and watersheds with less damage than high-severity fire. Natural fire reduces fuels and potential moderate adverse impacts to watersheds. Application of research burn knowledge is expected to yield short to long-term direct and indirect beneficial impacts to watersheds.

Mitigation actions are similar to Alternative B with the additions of: erecting brush or other structures to limit erosion and avoid silting rock pools and drainages; reestablishing native plants where needed; preventing the spread of exotics particularly into sites where native species are establishing; allowing natural ignitions in desert scrub and grasslands to slow the shrub encroachment; establish small research burns in areas where soils appear stable, seed sources of desired species are present, and knowledge of ‘fix-it’ techniques are known if the burn results are unsuccessful; use brush and other appropriate techniques to slow overland flows, increase infiltration, cool soil temperatures and generally improve conditions for germination and establishment of plants; control exotics that may have invaded scrub or grasslands.

Cumulative Effects

Cumulative effects may be similar to Alternative B but take longer to accrue. Research results in the Chisos from prescribed burns would then be reapplied under suitable climatic and management conditions. Any recovery in lowland deserts will be shaped by wet climate cycles more than fire events. These effects would cumulatively result in minor to moderate direct and indirect beneficial short-term effects to watershed integrity and long-term benefits to nutrient cycling.

Conclusion

The preferred alternative would result in long-term moderate direct and indirect beneficial effects. Low to moderate intensity research burns, assessment of fire effects and gradual reintroduction of natural ignitions based on this knowledge is expected to safely reduce fuels and preserve resources valued by the public. Fire management guided by research into restoration of lowland deserts may have direct and indirect benefits to watersheds over the long-term.

Under Alternative C, because there would be no major adverse impacts watersheds whose conservation is (1) necessary to the establishing legislation or proclamation of Big Bend National Park; or (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park’s general management plan or other relevant NPS planning document.

Impact Topic (8): Resources for the Fire Program

Big Bend is a large park with a relatively small fire program. The emphasis on the proposed action alternatives is to (1) reduce fuels to safe levels through a mix of wildland fire use, prescribed burns, and no-fire thinning, and to (2) better understand fire effects in a number of sensitive habitats. Staffing levels currently dictate that some routine tasks in most divisions are deferred. An increase in routine fire operations would drain the already taxed staff and suggests additional human resources are needed to support the increased level of fire program activities. Attempting to “make-do” with existing staff can lead to inadequate reporting, insufficient supervision of staff new to tasks, stress and burnout, and failure to adequately monitor pre-fire and post-fire burn sites for cultural resources and natural resource data. In addition, lack of time and resources may result in new data not being translated into management decisions. Currently, the park can cope with wildland fires to a limited degree with initial attack and confinement operations, and some extended attack efforts depending on the circumstances (for example: personnel availability, visitation numbers, risks, regional readiness, and logistical support).

Assessment Methodology

Evaluation of existing resources and proposed needs under action alternatives was obtained primarily from the Fire Management Officer based on experience catering to prescribed and wildland fires under the No Action Alternative (Alternative A).

Intensity of effects for resources for the fire program is defined as:

- Negligible: Impacts are at the lowest levels of detection with no additional staff or funding required.
- Minor: Detectable effect but additional staff and funding can be found from within existing park resources.
- Moderate: Effect is such that additional outside resources are needed for fire activities and outside funding is required to support such activities on a seasonal basis.
- Major: Additional permanent staff and resources are required to carry out fire management activities.
- Short-term: Duration of the planning and execution of fire program activities.
- Long-term: Long-term effects of insufficient resources extend beyond the FMP and cumulate in patchy research results, sporadic fulfillment of fuels assessment and fuels reduction, inability to provide monitoring timely or accurate monitoring data, all factors that limit knowledge for future decision making around fire effects.

Alternative A

Impact Analysis

The major thrust of the fire program under Alternative A is protection of developments through prescribed burns and mechanical and manual thinning. The park has maintained a ‘safety by suppression’ approach to lightning ignitions. Fuels continue to buildup in the Chisos and the park lacks the resources to confine or control large fires or a fire that spreads rapidly with multiple resource type requirements—engines, crews, and aircraft. Several years of above average rainfall (2002, 2003) combined with fuel buildup in the Chisos and unfilled key personnel positions, creates the potential for a high-intensity fire that would strain existing resources. The current alternative has contributed to direct and indirect moderate adverse impacts in the short-term and the long-term. How this situation is resolved adverse beneficial, depends on the level of training, availability of funding and personnel for seasonal firefighting, ability to undertake higher risk operations, and whether current key positions are filled, such as Engine Boss and Crew Boss.

Mitigation actions are: recruitment and training of seasonal Los Diablos firefighters from Mexico; training of existing staff; and sharing of trained staff from other departments, agencies and the region. Staff sharing occurs on a regional basis during extreme fire events.

Cumulative Effects

Cumulative effects under Alternative A include the diversion of fire staff assigned to other duties such as trail maintenance or interpretive activities due to rising visitation. The impact of this Alternative will vary depending on the year, number of fires, weather conditions in addition to regional conditions. Severe fire conditions in combination with increased visitation would create moderate adverse seasonally short- and long-term effects.

Conclusion

Under the current management direction there would be long-term minor to major adverse impacts to park values and resources as existing staff are called to meet increasing numbers of emergency fire situations.

Alternative B

Impact Analysis

More natural fire is expected in the park under Alternative B requiring intermittent non-predictable staffing needs. The fire program can create scenarios identifying needed staff and other resources but cannot predict which scenario will actually occur. Additional protection activities are planned for developments, selected cultural resource sites, and sensitive species habitats. Communications with neighbors about changing boundary agreements to create safer conditions for fire fighters and reduce damage to soils and vegetation – will take time. Effects depend on size, intensity and location of fire, the number of fires within a particular period and available support from other agencies and the region. Short-term minor to moderate direct adverse impacts are expected to resources if fires are large or occur before sufficient trained personnel and resources can be utilized.

Mitigation actions are: increasing preplanning such as fuels assessment prior to burning; allowing only low to moderate intensity burns; developing buffer areas and defensible space; identification of potential firelines and spike camps; use of a resource advisors; fine-tuning prescriptions; and recruitment and training of seasonal firefighters and permanent staff.

Cumulative Effects

Cumulative effects are similar to Alternative A but could be more adverse unless additional resources are available to meet higher demands for fuels reduction and more natural fire. Moderate direct adverse short to long-term impacts would be expected in high fuel areas of the park as staff are redeployed to cope with more fire related demands.

Conclusion

Under Alternative B, more frequent and larger natural fires, and more fuels reduction treatments are expected to tax existing staff, seasonal firefighters, engines, and equipment. Shifting from suppression under Alternative A to more routine fire events will require reassignment of staff priorities and/or hiring of additional staff with sufficient engines, equipment and safety training. Depending on how resource needs are met, these changes could be minor to moderate adverse (if met within the park) or beneficial (additional hires from outside the park) with direct and indirect long-term effects to park resources.

Alternative C

Impact Analysis

Under Alternative C, more natural and prescribed burns are allowed across the park after fuels assessment. Protection of developments will continue with a program of prescribed burns, thinning, mowing, and herbicide application. A unique aspect of this alternative is the use of research burns to better understand fire effects in sensitive habitats, particularly the woodlands and forests of the Chisos. Scientific design, pre-fire and post-fire monitoring, and evaluation of results will enable outcomes to be incorporated into management practices for these sensitive resource areas. Expanding, developing and maintaining this three-pronged approach to fire management will require a considerable change in direction for fire staff and managers. Not only will additional resources be required but also time for the planning, evaluation, and interpreting results into adaptive management.

Short to long-term minor to moderate direct and indirect adverse effects are expected if staff are reassigned from existing positions to share additional tasks. A benefit is that additional trained personnel available to assist with fire activities. The level of skill and experience for some tasks, such as scientific design of research burns, will required specialized backgrounds. Burns conducted in rugged terrain or around rare or threatened habitat may require that ignitors and/or firefighters receive additional training from specialized crews such as the “Hot Shots.”

Mitigation actions are: the recruitment of additional Los Diablos to handle prescribed and natural ignitions on a more routine basis in the park; filling key positions within the fire program including Engine Boss, Crew Boss and fuels specialist; determining priorities and methods for reducing fuels around cultural resource sites; and determining specific questions to be answered by research burns.

Cumulative Effects

Cumulative effects of Alternative C on park resources for the fire program will depend on the frequency, timing, and severity of fires. Prescribed burns will mostly occur outside the fire season when pressures on park fire crews are lowest. Allowing for more ignitions during fire season will increase pressures on permanent and seasonal resources within the park and regionally. In an emergency staff would be deployed from existing duties to provide logistical support as needed. If support is needed frequently, other planned projects such as construction of buildings and trails would be delayed and may incur additional costs – a short-term direct minor to moderate adverse impact.

Conclusion

Under Alternative C, impacts to resources for the current fire program and staffing levels are likely to result in moderate direct and indirect adverse effects. The expected increase in actions cannot be met without additional input from scientists for research burns, cultural resource specialists for protection of specific sites, knowledge of fire effects across the park (requiring pre-monitoring and post-monitoring (whenever possible)), and additional permanent or seasonal staff. These requirements are likely to instigate long-term changes in the park fire policy to enable adaptive management of resources and values.

Chapter V: Consultations and Preparers

Preparers

Alex, Betty, *GIS Specialist, Big Bend National Park*. BS in Wildlife Biology Corpus Christi State University. Five years sedimentation scientist with USGS, 24 years with NPS, 11 as activities clerk, 13 as GIS specialist. Performs spatial analyses, creates maps and coordinates mapping of all park resources; special interest in rare plants. Compiled all maps for this project and shaped rare plants information.

Alex, *Cultural Resource Specialist, Big Bend National Park* - BA in Cultural Anthropology from Stephen F. Austin University in Nacogdoches, Texas. 36 years experience in the field; contract archeologist for municipalities and mines in Texas and Louisiana; research assistant, supervisor for excavations and field supervisor; 20 yrs with NPS at Big Bend NP. Lead on cultural resource issues.

Bennett, Jeffery, *Hydrologist, Big Bend National Park*. BS from Sul Ross University, Alpine, TX in Earth Sciences, MS in Geology from Northern Arizona University, Flagstaff, AZ. 4 years soils/beach erosion and 5 years water quality in Grand Canyon NP, 3 years groundwater hydrogeologist, 1½ years at Big Bend NP. Lead on watershed effects.

Davila, Vidal, *Chief of Science and Natural Resources, Big Bend National Park*. BS in Recreation and Parks Administration from Texas A & M University. Management of cultural and natural resources at Armistad Recreation area 3yrs, Santa Fe Regional Office 1 year, Guadalupe NP 6 years, Great Basin NP 5 years and Big Bend NP a total of 15 years. Lead on compliance issues and correspondence with agencies.

Gatewood, Richard, *Fire Ecologist, National Park Service, Chihuahuan Desert Units*. Ph.D Disturbance and Restoration Ecology, Colorado State University. 4 years Ecologist, State of Texas; Research Associate, USDA Forest Service Rocky Mountain Experiment Station; 4 years Ecologist Bandelier National Monument. Lead on fire ecology and fire effects research and monitoring for the park. Technical representative between Big Bend NP and University of Arizona.

Moodie, Susan, *Research Associate, University of Arizona School of Renewable Natural Resources*. Ph.D. Candidate Arid Lands, University of Arizona. 5 years technical advisor, policy development community-based ecological restoration, Australia; 2 years organic market gardener New Mexico, 3 years entomology research, 2 years farming systems research Malawi, Africa, 4 years teaching and curriculum development. Lead coordinator for this EIS and associated compliance documents.

Morlock, John, *Fire Management Officer, Big Bend National Park*. BS in Conservation of Natural Resources from Texas A & M University; 7 years as River Ranger at Big Bend NP; 16 years as FMO at Bryce Canyon, Utah, El Malpais, New Mexico and Big Bend NP. Lead on fire management issues.

Skiles, Raymond, *Senior Wildlife Management Officer, Big Bend National Park*. B.S in Wildlife Ecology from Texas A & M University. Seasonal worker on interpretations, law enforcement and natural resources at Big Bend NP, Death Valley NP, Colorado NM, and Shenandoah NP; 1 year Washington D.C. public affairs; 17 years Big Bend as Wildlife Biologist. Lead on wildlife, federally listed species and fire effects.

Sirotnak, Joe, Botanist, Big Bend National Park. Ph.D in Ecology, Idaho State University. 4 years Botanist at Big Bend NP; 1 year Ecologist at Great Basin NP; 6 years Research Assistant in Ecological Research Idaho State University; 1 year Biological Technician; 1 year Research Biologist, Lead on vegetation categorization, federally listed plant species and fire effects; co-developed research approaches.

Reviewers:

Internal Review

Gebow, Brooke, *Senior Research Specialist, University of Arizona School of Renewable Natural Resources*. MS in Ecology and Evolutionary Biology from University of Arizona, 6 years energy consulting, 12 years free-lance science writer, 4 years Tucson Botanical Gardens, 5 years project support for UA USGS Sonoran Desert Research Station. Cooperator with the NPS to coordinate production of a number of NPS Fire Management Plans and associated compliance documents.

Peer Review

Lujan, John, *Superintendent Guadalupe Mountains NP*. BA in History from Sul Ross State University in Alpine, Texas: 27 years with the NPS at eight park units representing cultural, natural and recreational areas. Fire Management background includes fire fighting experiences across the west and southeast. Oversight of the development of the Interagency FMP between the NPS and the BLM.

Chronology

The preparation of this draft Environmental Assessment involved consultation between the NPS and UA partners, government agencies, and outside experts and researchers from December 2002 to December 2004. The chronology below identifies important scoping periods, meetings, and outside consultation.

12-11-02	Internal Scoping Meeting at Big Bend National Park; 18 staff present; goals and objectives of the fire program identified; issues and impact topics clarified using NEPA guidelines.
12-12-02	
4-14-03	Notice of Intent to produce an Environmental Impact Statement for FMP published in Federal Register.
6-10-03 to 7-30-03	Newletter mailed to park mailing list and also posted on the Big Bend National Park website. Public scoping comment period; period extended as newsletter sent mid May to public, agencies, researchers.
5-28-03	Meeting of IDT at El Paso. Identify vegetation categories (start) and fuel models
6-26-03	Public Scoping Meeting, Sul Ross State University, Alpine, Texas 5-7 pm.
6-27-03	Public Scoping Meeting, Community Center, Study Butte, Texas 5-7 pm.
11-20-03	Intiate consultation with USFWS to conduct Biological Assessment (BA) under Section 7 consultation requirements.
1-1-04	Meeting at Big Bend NP. Identified prescriptions for alternatives and finalized vegetation categories under FMP; conservatin measures for BA.
1-2-04	
1-04	List of tribal governments associated with park updated to seven.
1-27-04	First informal review of Biological Assessment by USFWS.
5-18-04	Informal review of draft BA by Texas Parks and Wildlife Service
6-1-04	Meeting at Big Bend NP with vireo experts to determine conservation measures under the FMP: John Maresh, John Cornelius, Bill Armstrong.
6-2-04	
5-04	Initiate consultation with TX SHPO for National Histoic Preservation Act Section 106 complainace
6-29-04	Meeting at Big Bend NP to develop fuels treatment program; identify watersheds at risk; develop research protocols; intiate maps
6-30-04	
7-10-04	Second informal assessment of BA by US FWS
10-04	Internal review of BA by park
10-04	Internal review of Cultural Resource Component by park
12-04	Notice of Intent to change Environmental Impact Statement to Environmental Assessment appeared in the Federal Register.

6-05	Peer review by Superintendent of Guadalupe Mountains National Park
6 05	Biological Assessment submitted to USFWS for formal evaluation
6 05	Cultural Resource Component submitted to TX SHPO for formal evaluation
6-1-05	Environmental Assessment released for review.

The Draft EA will be sent to agencies, tribes, and organizations. It will be accessible to the public through the Big Bend National Park website and a paper copy will be kept in the park visitor center. Landowners adjacent to the park (for whom the park has an address) and other interested individuals will be sent notification of the availability of the document, with information on how to obtain a copy. Public comments will be received for at least 60 days.

Following the public review period for the draft EA, a final EA will be developed that considers, addresses and seeks to resolve all substantive issues and comments raised by the public or agencies.

List of Recipients

The following will receive hard copies of the draft Environmental Assessment. A letter will be sent to the park's mailing list to inform interested parties of alternative methods of acquiring the DEA.

Carlsbad Caverns National Park\
Guadalupe Mountains National Park?
Big Bend Ranch State Park
Black Gap Wildlife Management Area
Sul Ross State Univeristy Library
Texas State Historic Preservation Office, Debra Beene
Texas Parks and Wildlife , Jackie Poole
U.S. Fish and Wildlife Service, Jana Milliken

Glossary

Appropriate Management Response (ARM)	Strategic and flexible response to fighting fire based on best information and experience available at the time; may include control (direct action to install firebreaks and stop a fire from spreading), containment (action on one or more sides of fire) or confinement (allowing a fire to burn to a barrier)
Biological Assessment (BA)	An assessment presented to U.S. Fish and Wildlife Service of effects on federally listed species, proposed listed species, or critical habitats of proposed federal actions that are not major construction projects (in this particular case, implementing a new FMP is the proposed action)
Biological Opinion (BO)	The opinion of the U.S. Fish and Wildlife Service on whether or not a proposed federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat
Context	The geographical or temporal environment of a proposed action, such that a change in the action relative to space or time might alter impacts
Control, contain, confine	A sequence of progressively less aggressive actions applied to wildland fire. <i>Control</i> consists of actions to suppress fire including installing firelines and suppressing hot spots, <i>contain</i> keeps fire within established boundaries and <i>confine</i> typically allows fire to burn itself out within a natural or constructed fireline.
Cultural Landscape	Landscapes as affected by people through time— the definition of such captures overlapping occupancy by different groups of people
Cultural Resources	Valued aspects of a cultural system that might be tangible (districts, sites, structures, objects)
Cultural Resources Component (CRC)	Document analyzing effects of the proposed action on cultural resources for review by the State Historic Preservation Office
Cumulative Effect	Effects of actions (those in the past, present, or reasonably foreseeable future) that have an additive impact on the resources affected by the proposed action
Debris Flow	“Rivers” of earth, rock, and debris saturated with water; one cause is intense summer thunderstorms following removal of organic matter from soils by fire
Direct Effect	An impact that occurs as a result of the proposed action or alternative in the same place and at the same time as the action
Duration	The length of time of effects of an action
Duff	Decomposing organic matter lying beneath the litter layer and above mineral soil
Ecoregion	A large-scale area with a common geological and biological history
Exotic Species (also non-native)	Species not native to a particular ecosystem
Fire break	A natural or manmade barrier to fire, such as a river, road, or excavated line, that is devoid of flammable vegetation
Fuel continuity	Describes how connected fuels are horizontally across the ground and vertically

Glossary

	into canopies; continuous fuels support fire spread
Fire frequency/return interval/ fire cycle	The recurrence of fire in a given area/habitat over time
Fire intensity	The amount of energy released by the fire usually measured as per unit length of fire front; reported as low, moderate or high
Fuel moisture	Most important determinant of flammability; varies daily within plants but over a lifetime plants become drier and more flammable as they mature
Fire severity	Qualitative measure of mortality and survival on above ground plants and animals and below ground effects on loss of organic matter; determined by heat released; little organic matter is removed or tree canopy scorched under low severity, while high severity signals very hot burns removing soil organic matter and burning forest canopy
Fire Management Plan (FMP)	The plan that guides all fire-related activities at a park that is consistent with land and resource management plans and follows NPS guidelines
Fire Management Unit (FMU)	A delineated area of the park that permits particular fire management strategies
Fuel	Vegetation, both living and dead, capable of burning
Fuel management	The use of methods such as prescribed fire and manual and mechanical means to reduce flammable vegetation that accumulates over time
Impairment	Impacts on resources that negatively, significantly, and possibly irreversibly alter their character from the state that made them important to protect in a park
Ground fire	Burns down through the litter into the duff and organic matter; can kill roots and destroy soil seedbanks
Indirect effect	An impact that occurs as a result of the proposed action, but removed in time and space from the action
Intensity	Magnitude of effect, from low to high
Inter-disciplinary team (IDT)	Group of interdisciplinary specialists that identifies important issues, relationships, and alternatives for public scrutiny
Manual fuel reduction	Removal of vegetation or creation of fire breaks using hand tools and chainsaws
Mechanical fuel reduction	Removal of vegetation or creation of fire breaks by bulldozer or road grader
Minimum requirement	The lowest impact means of accomplishing a task, frequently considered with respect to wilderness
Mitigation	Modification of an action that lessens intensity of its impacts on a particular resource
Monitoring program	Collecting information in a systematic way on species, species distribution, growth, fuel loading and health, archeological remains, before and after prescribed burning and after natural ignitions
National Environmental Policy Act (NEPA)	The 1969 law that dictates the objective analysis and public scrutiny of the environmental as well as social and economic impacts of proposed federal

Glossary

	actions and their alternatives prior to implementation
Natural resources	A feature of the natural (physical and biological) environment that has value to humans
No Action	Under NEPA, No Action continues the current planning and operational direction and provides a baseline against which other alternatives can be measured
Non-fire treatments	Removal of vegetation without using fire, most commonly through mechanical/manual means including mowing, slashing, chainsaws or herbicidal treatments
Non-native species	Species not native to a particular ecosystem (used like “exotic”)
Prescribed fire	Fire ignited by management to meet specific objectives
Prescription	Measurable environmental criteria, particularly temperature, relative humidity, wind speed and direction, and fuel moisture, that define the conditions under which a fire would be ignited by management, guide selection of appropriate management responses, and indicate other required actions
Research burn	Prescribed burns with greater investment in examining, recording, analyzing, evaluating and applying monitoring results of fire effects and fire dynamics to management decisions
Resource advisor	An expert in a particular resource area (such as an archeologist or botanist) who is brought on site to advise fire crews relative to protecting sensitive resources
Rhizome	Creeping stem growing beneath the soil surface sending up new leaf shoots from nodes; characteristic of lechuguilla, saltcedar and Bermuda grass
Root crown	Mass of woody tissues from which stems and roots originate; usually applied to shrubs and herbaceous plants; often indicates drought tolerance and ability to resprout after fire
Scoping	Compilation of knowledge and opinions in order to properly develop and decide on alternative courses of action, both internally to the park and externally with the public
Sensitive species	Species sensitive to perturbation from the proposed action, frequently rare species that are federal or state-listed, proposed for listing, occurring in very few places, or particularly sensitive to the action’s impacts
Species diversity	A measure of the number of species in an area (species richness) that also accounts for species abundance
State Historic Preservation Office	The state office overseeing protection of cultural resources
Succession	The natural evolution of biotic communities over time following disturbance
Suppression	All the work of extinguishing a fire beginning with its discovery, using confine, contain, and control actions
Thinning	Reduction of density of vegetation, frequently using non-fire means

Glossary

Timing	How effects vary depending on when the action takes place
U. S. Fish and Wildlife Service	U.S. Department of Interior agency charged with overseeing protection of threatened and endangered species
Unique Sites	Sites sufficiently uncommon such that their presence is a special feature of the park with intrinsic value and of interest to visitors
Unique Stands	Patches of vegetation that are uncommon in an area that may be relicts from an earlier age
Watershed	Land above a given point in a drainage that potentially contributes water to the streamflow at that point
Wilderness	Designated area managed to perpetuate natural processes and minimize human impacts
Wildland fire	Any fire except prescribed fire or fire in developments, that occurs in the wildland or backcountry
Wildland Fire Use (WFU)	Naturally (lightning) ignited fire managed to meet resource benefits

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Appendix A: Full list of issues related to fire management planning at Big Bend National Park.

Identified from the Intermountain Regional Office Environmental Screening Form (IMRO ESF). Meeting held at Big Bend NP December 11-12, 2002.

Impact Area	Topics from ESF	Issues, Concerns, Opportunities	
<i>Human Experience & Interaction</i>	Visitor Experience		
	safety	<ul style="list-style-type: none"> • Fire can put visitors, staff and firefighters at risk • The use of fire can reduce hazard fuels • Evacuations could adversely affect visitor experience and be costly • Hikers and campers in wilderness are at risk • A single road into and out of the Chisos Basin could cause evacuation problems 	
	air quality	<ul style="list-style-type: none"> • This class I airshed allows broad day time views • Smoke obscures views 	
	night skies	<ul style="list-style-type: none"> • Crystal clear views are obscured but smoke creates great sunsets 	
	mechanical sounds	<ul style="list-style-type: none"> • Equipment used during suppression is noisy (chainsaws, helicopters, vehicles and generators) 	
	views	<ul style="list-style-type: none"> • Cherished views may become charred • Fire may enhance and reveal new vistas 	
	visitation interpretation	<ul style="list-style-type: none"> • Some visitors may seek alternate destinations • Fire operations and sites provide interpretative opportunities 	
	recreational opportunities	<ul style="list-style-type: none"> • Trails, vistas, campgrounds, and roads may be temporarily closed 	
		Land Use	
		property damage	<ul style="list-style-type: none"> • Structures, signage and landscaping are at risk
	neighbors	<ul style="list-style-type: none"> • Fire may cross boundaries- private, state and international • Ranch inholdings may lose grazing, fences, and livestock • Loss of telephone and utility poles may lead to litigation against the park 	
	local economy	<ul style="list-style-type: none"> • Hunters camping on inholdings may start illegal campfires • Tourism may decline after a well-publicized fire resulting in loss of income to local merchants and the park 	
Natural Resources	Vegetation		
	composition	<ul style="list-style-type: none"> • Fire intolerant species suffer • Fire-tolerant species benefit from decreased competition such as mid-elevation grasses • Diversity can increase after fire • Diversity can decrease with fires in fire-adapted exotics 	
	structure	<ul style="list-style-type: none"> • Intense fires can eliminate entire stands of vegetation 	
	unique stands	<ul style="list-style-type: none"> • Fire may damage or eliminate unique stands of vegetation where there are no colonizing seed sources 	
	non-indigenous species	<ul style="list-style-type: none"> • Fire facilitates invasion by exotic fire-tolerant buffelgrass, Bermuda grass, Johnson grass, saltcedar, Russian thistle, Lehmann's lovegrass and giantreed. 	
		Species of Special Concern	
	plants	<ul style="list-style-type: none"> • Rare, protected, or listed plants may suffer injury, death, or destruction of habitat by fire • Fire adapted species benefit from reduced competition • Nutrient ash may be beneficial to seedlings 	
	animals	<ul style="list-style-type: none"> • Rare, protected, or listed animals may suffer injury, death, or destruction of habitat by fire 	

Impact Area	Topics from ESF	Issues, Concerns, Opportunities
		<ul style="list-style-type: none"> The effects of fire on the habitat of many species is unknown Fire creates edge habitat preferred by some species Fire can increase browse and forage for deer Fish and mussels could be affected by petroleum leaking into creeks from trucks and igniters used in fire management activities Reducing brush around springs can increase subsurface flows benefiting amphibians and fish Reducing brush can also increase trampling around springs and raise water temperatures
	<p>Important Wildlife Considerations</p> <p>key species</p> <p>fire timing</p>	<ul style="list-style-type: none"> Fire may kill, injure, or displace species that visitors want to see such as black bear, mountain lion and Colima warblers Fires during breeding seasons can disrupt nesting and maturation of species Species adapted to cyclical fire will recover provided that there are sufficient populations for recolonizing and enough remaining habitat
	<p>Unique Sites</p> <p>ecoregions</p> <p>education</p> <p>natural sites</p>	<ul style="list-style-type: none"> The Chisos Mountains and Pine Canyon are unique in the US and perhaps the US-Mexico region containing relic populations of aspen and Arizona Cypress, and many endemic species Opportunities exist to use these special areas to illustrate the importance of the Biosphere designation Meadows, grasslands, savannahs, dunes, springs, limestone habitat, woodlands and forest
	<p>Wilderness</p> <p>ecology</p> <p>visitor experience</p> <p>fire operations</p>	<ul style="list-style-type: none"> Allowing fire maintains natural succession processes Presence and effects of fire help maintain the integrity of wilderness Evacuations from wilderness can be challenging Fire operations may attract people to closed areas hampering operations Restrictions on suppression techniques in wilderness can determine the course of fire
	<p>Geological Resources</p> <p>soils</p> <p>education</p> <p>visual quality</p>	<ul style="list-style-type: none"> Fire can negatively impact soils by reducing infiltration, initiating erosion, silting waterways and roads, and transporting weed seed Exposed vistas and features offer opportunities for interpretation and education Exfoliation and blackening (spalling) creates stark visual impacts
	<p>Geohazards/mudflows</p>	<ul style="list-style-type: none"> Potential for increased runoff and erosion when rain hits bare soils Potential for flooding increases with storms following fires Creek drainages and other aquatic habitats vulnerable from silt and debris

Impact Area	Topics from ESF	Issues, Concerns, Opportunities
	Water	<ul style="list-style-type: none"> • Less vegetation after fire results in greater runoff • Runoff from slopes will contain increased particulate load; may change pH of streams affecting aquatic life
	quantity	
	quality	
	Floodplains/wetlands	<ul style="list-style-type: none"> • Excessive sediment loads in Rio Grande may affect relationships with downstream users • Waters may become polluted with petroleum from suppression activities • Water taken for suppression may decrease availability in already low areas • Knocking back thickets near streams can increase flows benefiting wildlife • Removal of tamarisk can lead to a rise in the watertable • Sites may become drier following fire • Vegetation may be trampled during suppression • Some springs may be more heavily used when fire removes the surrounding vegetation
	hydrology	
	vegetation	
	wildlife	
Cultural Resources	Cultural Resources	<ul style="list-style-type: none"> • Suppression activities can directly damage site features and contribute to loss of significant archeological context • Fires can expose sites to vandalism • Fires cause loss of vegetative cover which open sites to erosion • Only 3% of the park is surveyed and damage could occur inadvertently • Timbers, glass, metals and ceramics can be destroyed by fire in historic structures • Historic artifacts on the surface and in trash dumps are important for interpreting use of the site and can be adversely damaged by fire and suppression activities • Cultural sites are not well documented; losses could be permanent or recoverable only after long periods • The vegetative component of a landscape may be a significant character defining resource to preserve instead of burn
	archeological sites	
	structures	
	cultural landscapes	
Federal and State Policies	Agency Policies	<ul style="list-style-type: none"> • The park works with the USFWS on protection of threatened and endangered species • The park works with the Texas State Historic Preservation Office on protection of cultural resources • Existing agreements of cooperation exist; Los Diablos fight fires in the US. New agreements are being developed • Agreements are being developed to work with several species of concern, and on fire along the border of the Blackgap Wildlife Management Area • Agreements will be developed as needed • Formal agreements are being developed on an on-going basis to accommodate more cost-effective and ecologically sound suppression policies along park boundaries
	U.S. Fish & Wildlife Service	
	Texas SHPO	
	Mexico	
	Texas Parks & Wildlife	
	Tribal Affiliates	
	Neighbors	

Appendix B. Fire Effects on Dominant Plant Species in Big Bend National Park

Table B-1. Floodplain and Upland Riparian

Table B-2. Scrub Desert

Table B-3. High Desert Grasslands

Table B-4. Shrub Woodlands

Table B-5. Grassy Woodlands

Table B-6. Forest

Table B-1.Floodplain and Upland Riparian: Fire Ecology of Main Species. FEIS is the Fire Effects Information System maintained by the USDA Forest Service that contains literature reviews: <http://www.fs.fed.us/database/feis/>.

Species	Fire Ecology/Adaptations	Source
<i>Baccharus halimifolia</i>	Shrubby groundsel tree is killed by fire and recolonization probably requires windborn seed sources.	FEIS
<i>Chilopsis linearis</i>	Desert willow can be top-killed by fire but resprouts from the root crown becoming multi-stemmed.	FEIS
<i>Muhlenbergia rigens</i>	Deer muhly is not included in the fire literature. Other grass species show variable response depending on fire season, top growth and post-fire conditions. Dense basal cover may protect growing points on a low-intensity fire; high fuels and intensity may lead to plant death. Reestablishment is probably by seed.	FEIS
<i>Populus fremontii</i>	Cottonwoods are easily killed by fire and resprouting from root crown is diminished after 25 years. Can reestablish by seed in absence of competitive vegetation.	FEIS
<i>Prosopis glandulosa</i>	Honey mesquite resprouts readily following topkill from buds on extensive underground root systems.	FEIS
<i>Prosopis pubescens</i>	Screwbean is more easily top-killed or killed by fire than other mesquites. Resprouts weakly; easily outcompeted by saltcedar.	FEIS
<i>Sporobolus airoides</i>	No literature on Alkali sacaton but other species respond after fire depending on amount of root crown loss, season of burn and post-fire precipitation.	FEIS
Exotic species		
<i>Arundo donax</i>	Giantreed is highly flammable year round; top-killed by fire but resprouts vigorously from rhizomes and overtakes native vegetation.	FEIS
<i>Cynodon dactylon</i>	Above ground stems are consumed by fire but Bermuda grass responds vigorously from rhizomes if moisture is available.	FEIS
<i>Pennisetum ciliare</i>	Buffelgrass is a warm-season perennial that resprouts following fire and also reestablishes by seed stored in soil. It may increase cover following fire.	
<i>Tamarix ramossissima</i>	Saltcedar can resprout from root crowns and stem pieces; buildup of fuels within plant increases flammability; post-fire response can lead to dense thickets.	FEIS

Table B-2. Desert Scrub: Fire Ecology of Main Species. FEIS is the Fire Effects Information System maintained by the USDA Forest Service that contains literature reviews:
<http://www.fs.fed.us/database/feis/>.

Species	Fire Ecology/Adaptations	Source
<i>Agave lechuguilla</i>	Lechuguilla occurs in dense stands that can readily carry hot fire; mortality tends to be high; some plants survive and produce offsets; plants can escape fire by living in rocky microhabitats.	FEIS
<i>Bouteloua curtipendula</i>	Sideoats grama response to fire depends on growth form, climatic conditions, season of burn, and severity of fire; reestablishment occurs through seed and/or rhizomes; recovery time is variable, but 2 to 3 years may be required.	FEIS
<i>Flourensia cenua</i>	Little is known about the effects of fire on Tarbush. Fire is not expected to kill except if buildup of understory fuels.	FEIS
<i>Fouquieria splendens</i>	Ocotillo is easily damaged by fire; less in the dormant season; can resprout from root crown after low-intensity fire; occurs where fire is unlikely except after wet years and buildup of grasses.	FEIS
<i>Hechtia texensis</i> <i>Larrea tridentata</i>	Texas falseagave or Hetchia Creosote's resinous leaves are very flammable but sparse grasses and patchy fires mean few creosote burn. They resprout weakly.	FEIS
<i>Opuntia</i> spp.	Prickly pear is consumed by hot fire. Surviving pads that connect with the ground may reestablish.	McPherson 1995
<i>Parthenium incanum</i> <i>Yucca</i> spp.	Mariola – resprouting effects unknown Yucca increases in the absence of fire. Can resprout from buds under the stem depending on fire severity.	FEIS
<i>Hilaria mutica</i>	Tobosagrass response to fire depends on season of burn, soil moisture and post-fire precipitation regimes; recovery appears to take several years. Underground rhizomes send out new shoots. Slow burning hot fires can be very damaging.	FEIS Humphrey 1974
Exotics		
<i>Pennisetum ciliare</i>	Buffelgrass is top killed by fire and reestablishes from seed stored in soil.	FEIS
<i>Eragrostis lehmanniana</i>	Lehmans lovegrass survives fires by sending new shoots from underground stems or from seed. Severe fire kills most plants but rains following fire can lead to rapid reestablishment.	

Table B-3. High Desert Grasslands: Fire Ecology of Main Species. FEIS is the Fire Effects Information System maintained by the USDA Forest Service that contains literature reviews: <http://www.fs.fed.us/database/feis/>.

Species	Fire Ecology/Adaptations	Source
<i>Acacia constricta</i>	Catclaw acacia can resprout from the root crown following top-kill. Severe fires will destroy underground roots.	FEIS
<i>Agave lechuguilla</i>	Lechuguilla burns hotly and suffers high mortality. Surviving rosettes and blades reestablish after several years.	FEIS
<i>Aristida</i> spp.	Three-awns suffer damage from fire with growing points close to the soil surface. A 1975 fire in November in Big Bend led to 650% increase in forb and succulent cover over grasses.	FEIS
<i>Bouteloua breviseta</i> <i>Bouteloua eriopoda</i>	There wa no literature for Chino grama Black grama has the reputation of being fire-sensitive, recovering slowly after fire through vegetative growth; healthy stands recover more readily, given decent moisture; carries fire if cover dense and conditions windy.	FEIS
<i>Bouteloua gracilis</i>	Blue grama is topkilled by fire, but fire generally increases occurrence, production, and cover; seed and seedstalk production may also be stimulated by fire; wet years post-fire increase yield.	FEIS
<i>Bouteloua hirsuta</i>	Hairy grama cover was positively correlated with fire frequency in Minnesota; most studies conclude it is undamaged by fire following a season or two of depressed production.	FEIS
<i>Dalea</i> spp. <i>Dasyilirion wheeleri</i>	<i>Dalea</i> spp. Young sotol are easily killed; mature sotol with trunks sheathed in dead leaves makes them especially susceptible to fire; stalks attract lightning; plant tops spread fire by falling off and rolling downhill; plants occasionally resprout if lightly or moderately burned.	FEIS
<i>Digitaria californica</i>	Recovery of California cottontop depends on post-fire moisture; wet summers can lead to full recovery; growing points are protected underground.	FEIS
<i>Lepochloa dubia</i> <i>Leucophyllum minus</i> <i>Nolina microcarpa</i>	Green sprangletop Ceniza Bear-grass or Sacahuista resprouts from the woody, underground caudex after fire; cool fires result in little or no mortality; hot fires kill many young plants and some mature plants.	FEIS
<i>Opuntia</i> spp.	Prickly pear is susceptible to fire but rarely are all plants or parts burned. Resprouting from the root crown or from layering of surviving pads. Increased	FEIS

<i>Pleuraphis mutica</i> <i>Sporobolus airoides</i>	fire frequency is thought to increase mortality. Tobosagrass No literature on Alkali sacaton but other species respond after fire depending on amount of root crown loss, season of burn and post-fire precipitation.	FEIS
<i>Viguiera stenoloba</i> <i>Yucca torreyi</i>	Skeletonleaf goldeneye is highly flammable. Yucca flowerstalks act as lightning receivers ; mature dead skirts of leaves are consumed by fire and may spread fire as the plant rolls downhill.	FEIS

Table B-4. Shrub Woodlands: Fire Ecology of Main Species. FEIS is the Fire Effects Information System maintained by the USDA Forest Service that contains literature reviews:
<http://www.fs.fed.us/database/feis/>.

Species	Fire Ecology/Adaptations	Source
<i>Aloysia gratissima</i>	Bee bush is not known to be easy to ignite or burn	Staff observation
<i>Acacia constricta</i>	Catclaw acacia can resprout from root crowns provide the fire is not severe.	Big Bend. FEIS
<i>Juniperus pinchotti</i>	Mature redberry or Pinchot juniper resists fire; will resprout following topkill if the basal bud is protected by soil; prescribed fire kills seedlings and saplings. Extreme conditions needed to kill mature trees.	FEIS
<i>Juniperus deppeana</i>	Alligator juniper canopies are often high enough so that fires scorch but do not severely damage the crown. Bark also provides protection from fire. It is generally capable of prolific sprouting after aboveground vegetation is consumed by fire, particularly if the resprouting zone is covered by soil.	FEIS
<i>Quercus grisea</i>	No information in the literature on Gray oak. Most oaks survive low-intensity, fast-moving fire. Fires in closed canopy oak forests probably lead to stand replacement.	FEIS
<i>Quercus emoryi</i>	Emory oak resprouts vigorously from root crown or stump following fire; fire probably occurred every 10-20 years where lower elevation grasslands led into Madrean oak-pine woodlands.	FEIS
<i>Rhus virens</i>	There was no information on fire effects in the literature for Evergreen sumac. Other sumacs are top-killed by fire but resprout from root crowns and reestablish by seed. Some species increase following fire.	FEIS
<i>Vauquelinia corymbosa</i> subsp. <i>angustifolia</i>	Slimleaf vauquilinia	

Table B-5. Grassy Woodlands: Fire Ecology of Main Species. FEIS is the Fire Effects Information System maintained by the USDA Forest Service that contains literature reviews: <http://www.fs.fed.us/database/feis/>.

Species	Fire Ecology/Adaptations	Source
<i>Achnatherum hymenoides</i>	Pinyon rice grass is relatively open limiting damage to below ground parts; usually top-killed by fire and reestablishes by seed. Not intensively researched	FEIS.
<i>Agave harvardiana</i>	Mature Harvard agave may take several years to die following fire. Young rosettes under the skirt of an adult are usually consumed by fire.	Howard 1996; Johnson 2001
<i>Garrya wrightii</i>	Wright silktassel resprouts from the root crown following fire. Most information comes from chapparal in Arizona.	FEIS
<i>Juniperus deppeana</i>	Alligator juniper canopies are often high enough so that fires scorch but do not severely damage the crown. Bark also provides protection from fire. It is generally capable of prolific sprouting after aboveground vegetation is consumed by fire, particularly if the resprouting zone is covered by soil.	FEIS
<i>Juniperus flaccida</i>	Specific information about fire effects is lacking; shedding bark and volatile leaf oils probably make it very flammable and easily killed. Patchy burns would allow it to survive in refugia.	FEIS
<i>Juniperus pinchotti</i>	Mature redberry or Pinchot juniper resists fire; will resprout following topkill if the basal bud is protected by soil; prescribed fire kills seedlings and saplings. Extreme conditions needed to kill mature trees.	FEIS
<i>Muhlenbergia emersleyi</i>	Low fire intensity can be survived but intense fire usually kills; reestablishment is by seed	FEIS
<i>Pinus cembroides</i>	Fire effects on Mexican pinyon depend on stand density and understory species and fuel levels. Mature 80 year old trees with grassy understory are fire resistant, young trees in dense stands are easily killed.	FEIS
<i>Quercus grisea</i>	No information in the literature on Gray oak. Most oaks survive low-intensity, fast-moving fire. Fires in closed canopy oak forests probably lead to stand replacement.	FEIS
<i>Quercus emoryi</i>	Emory oak resprouts vigorously from root crown or stump following fire; fire probably occurred every 10-20 years where lower elevation grasslands led into Madrean oak-pine woodlands.	FEIS
<i>Quercus gravesii</i>	There is no literature on Graves oak but most oaks can resprout from the root crown following fire.	

Table B-6. Forest: Fire Ecology of Species. FEIS is the Fire Effects Information System maintained by the USDA Forest Service that contains literature reviews: <http://www.fs.fed.us/database/feis/>.

Species	Fire Ecology/Adaptations	Source
Dominant		
<i>Juniperus deppeana</i>	Alligator juniper canopies are often high enough so that fires scorch but do not severely damage the crown. Bark also provides protection from fire. It is generally capable of prolific sprouting after aboveground vegetation is consumed by fire, particularly if the resprouting zone is covered by soil.	FEIS
<i>Juniperus flaccida</i>	Specific information about fire effects is lacking; shedding bark and volatile leaf oils probably make it very flammable and easily killed. Patchy burns would allow it to survive in refugia.	FEIS
<i>Juniperus pinchotti</i>	Mature redberry or Pinchot juniper resists fire; will resprout following topkill if the basal bud is protected by soil; prescribed fire at 10-20 year intervals kills seedlings and saplings. Extreme conditions needed to kill mature trees.	FEIS
<i>Pinus cembroides</i>	Fire effects on Mexican pinyon depend on stand density and understory species and fuel levels. Mature 80 year old trees with grassy understory are fire resistant, young trees in dense stands are easily killed.	FEIS Moir (1982)
<i>Quercus gravesii</i>	Graves oak	
Subdominant to rare		
<i>Acer grandidentatum</i>	Bigtooth maple live in moist sites , produce shady crowns that suppress understory and tend to burn infrequently; following crown destruction by fire, some resprout from root crown, but not vigorously.	FEIS
<i>Arbutus xalapensis[texana]</i>	Observation of fire scars on Texas madrone suggest some survival after fire; moist habitats generally protect from fire; post-fire sprouting is not documented but not ruled out; bird-dispersed seed may establish on burns.	FEIS: Staff observation Guadalupe Mountains NP
<i>Cupressus arizonica</i>	Arizona cypress less than 4" in diameter is killed by fire; relict populations probably survived patchy fast-moving grass fires; fire stimulates seed release.	FEIS
<i>Ostrya chisosensis</i>	Information on Chisos hophornbeam not available . Other hophornbeam species believed to be killed by fire; occur in juniper-pinyon communities that burned every 10-30 years	FEIS
<i>Pinus ponderosa</i>	Interior ponderosa pine can survive considerable scorching. Fire adaptations include: open crowns; self-pruning branches; thick, insulative, relatively unflammable bark; thick bud scales; tight needle	FEIS

	bunches that open into a loose arrangement that does not favor combustion; high foliar moisture; and a deep rooting habit.	
<i>Populus tremuloides</i>	Much work on quaking aspen comes from the northern Rockies and eastern U.S.; the species is topkilled by fire, but sends up a “profusion” of stems for several years post-fire; new stands can develop within a decade; fire-scarred aspens in Utah showed 7- to 10-year fire frequency pre-1885; lack of young stands in the west may be due to absence of fire.	FEIS
<i>Pseudotsuga menziesii</i>	Mature Rocky Mountain Douglas-fir is generally more fire resistant than spruces and true firs and equally or slightly less fire resistant than ponderosa pine. Mature trees can survive moderately severe ground fires because thick, corky bark insulates the cambium from heat damage. Where fire is frequent young trees are killed.	FEIS
<i>Quercus rubra</i>	Mature red oak can survive fires with up to 66% bark burn but are more susceptible than other oak species; trees may resprout from the root crown. Mortality increases with fire severity.	FEIS
<i>Quercus rugosa</i>	Netleaf oak. No literature on this species; severity of fire and protection of root crown determine resprouting in many oak species.	

Appendix C. Cultural Resource Matrix

This matrix was completed by Tom Alex and reviewed as part of the Cultural Resource Component (the document that summarizes all cultural resource concerns under the FMP) by W. Andy Cloud at Sul Ross State University at Alpine. The Texas State Historical Preservation Office reviewed the CRC.

The 6-page matrix considers historical, archeological, architectural, engineering, and cultural values to identify resources sensitive to fire program activities. It also specifies the particular aspects of the resource at risk, reviews what fire program activities create the risk, defines protection objectives for these resources, and suggests methods to minimize or mitigate impacts in order to achieve these objectives. An initial itemized list of treatment by site has been developed to guide operations under the new FMP.

Definition of terms:

Historic contexts are the historic and prehistoric themes under which various resources were created and used. Individual resources are best understood and evaluated by understanding the roles they played within specific historical periods. For example the various eras of the Prehistoric American Indian Period are characterized by changes in specialized hunting tools. Military forts or presidios, mining, and ranches characterize the Mexicans and Anglos Historic Period. The park period features superb rock construction by the Civilian Conservation Corps.

Resource types represent general function or morphology such as historic districts or cultural landscapes. They include stone hunting tools from prehistoric times, the remains of mines, farming systems and military establishments, and some resources more difficult to date such as lithic scatters.

Elements are the specific physical characteristics of resource types. Identifying the elements allows us to define specific elements or values at risk from various fire management activities. Historical buildings may contain burnable wooden timbers, glass that may melt, or ceramics that may crack under high temperatures. Retardant or water may crack or shatter rocks heated by fire within an archeological site.

Risk conditions or activities are the specific environmental conditions and/or fire management activities that place particular resources at risk. Growth of brush around historic sites increases the temperature of fire; the presence of burnable timbers, glass, metals and ceramics creates risks best mitigated by removal of nearby flammable materials.

Fire management objectives guide actions in a way that protects the elements or values at risk. The CRC recommends a variety of approaches for reducing risk from fire depending on the site and its components.

Treatments or prescriptions are methods of attaining the objectives for cultural resources. The park has prepared a preliminary list of sites and proposed treatments for consideration under the fire program.

Treatments include:

- Reducing fuels in and around sites through manual or mechanical thinning, prescribed fire or natural ignitions depending on site.
- Manage nearby fire to ensure that sensitive resources are not affected by fire containment or suppression activities.
- Prior identification of vehicle access and fire breaks around sites with high public visitation.
- Undertaking cultural resource inventories designed by qualified cultural resource specialists in burn units prior to prescribed burn activities.

Seven tribes are affiliated with the park. Apache Tribes of Oklahoma, Blackfeet, Comanche Tribe of Oklahoma, Kickapoo Traditional Tribe of Texas, Kiowa Tribe of Oklahoma, Mescalero Apache Tribe,

and Ysleta Del Sur Pueblo. Also consulted are relevant state and federal agencies, local governments, local businesses, and private residents living along the boundary or nearby the park.

The park sent out public scoping newsletters in June 2003 and held open house meetings in Alpine and Study Butte, Texas. The comment period extended to the end of August 2003. Tribes were not informed within the original comment period because of confusion about which tribes were affiliated with the park. Research by staff in Santa Fe NPS and the park Tribal Liaison Officer, expanded the original list from 3 to 5 and then to 7 tribes. Each tribe will receive a copy of the draft EA when completed and invited to comment on the alternatives.

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Historic Context	Resource Type	Elements	Elements or Values at Risk	Risk Conditions	Management Objectives	Treatment or Prescriptions
INDIGENOUS AMERICAN POPULATIONS: Prehistoric Archeology: Prehistoric Use of Natural Stone Sources and Regional Trade	Lithic source, quarried	Quarry Alcoves Quarry Pits Lithic concentrations	Extraction and lithic reduction techniques Chronological and functional data Dating/sourcing	Heat spalling of rock surfaces in alcoves from high intensity/ long residence fire; Ground disturbance; Retardant drops; Temperatures >500C	Avoid disturbance	Pretreatment: hand lines/ring firing; Use water where possible to suppress
	Lithic Source, Surface	Lithic concentrations	Chronological and functional data Lithic reduction techniques Dating/sourcing	High intensity/ long residence fire; Ground disturbance; Retardant drops; Temperatures >500 C	Avoid disturbance	Pretreatment: hand lines/ring firing; use water where possible to suppress
INDIGENOUS AMERICAN POPULATIONS: Prehistoric Resource Use, Landscape Use and Settlement Patterns 10,000 BC – AD 1550	Open Campsite	Stone-paved/lined hearths Lithic concentrations	Chronological and functional data Feature integrity Dateable contents of hearths Lithic reduction techniques Lithic sourcing	Moderate to high intensity/ long residence fire; Ground disturbance; Chemical retardant drops; Radiocarbon data contamination from vegetation growth contacting features; Temperatures 300-500 C	Avoid ground disturbance	Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
	Sheltered Sites: Boulder Shelter	Petroglyphs Pictographs Midden Lithic concentrations	Morphological and stylistic data Pigment dating Chronological and functional data Lithic reduction technology Subsistence data	Heat spalling of rock surfaces; Vegetation growth contacting features; Smoke blackening; Radiocarbon data contamination; Temperatures >500 C	Avoid ground disturbance Suppression	Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
	Sheltered Sites: Rock Shelter	Middens Rock art Vegetal artifacts Stone artifacts Storage cysts Lithic caches Burials	Feature integrity Interpretive value Chronological and functional data Morphological and stylistic data Pigment dating	Heat spalling of rock surfaces; Radiocarbon data contamination from vegetation growth contacting features; Smoke blackening Heat alteration of biotic/mineralogic surface coatings Temperatures >50 C	Avoid ground disturbance Suppression	Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
	Food processing sites	Cooking pits Bedrock mortars & metates Molcajetes & metates Plant/animal processing tools	Chronological and functional data Subsistence data Lithic reduction techniques Hunting/Gathering methodology	Heat alteration of biotic & mineralogic surface coatings; Radiocarbon data contamination from vegetation growth contacting features; Temperatures >50 C	Avoid ground disturbance	Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation

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Historic Context	Resource Type	Elements	Elements or Values at Risk	Risk Conditions	Management Objectives	Treatment or Prescriptions
	Vision quest/ceremonial observation	Mountaintop stone enclosures Hearths Molcajetes and metates	Ceremonialism and spirituality Chronological data Stone alignments and cairns integrity	Moderate to high intensity/residence fire; Radiocarbon data contamination from vegetation growth contacting features; Heat alteration of biotic/mineralogic surface coatings Temperatures >50 C	Avoid ground disturbance	Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
	Medicine Wheel	Stone lines & circles, horizon alignments, stone mounds and cairns Human burials and associated artifacts Artifact caches	Ceremonialism and spirituality Human remains Mortuary practices Commemorative practices Stone alignments and cairns integrity	Foot traffic Fireline construction	Avoid ground disturbance Suppression	Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
	Burial Sites	Crevice burials: rock mounds and walls Subsurface burials: rock mounds or paved surfaces Pictographs and petroglyphs Associated artifact/burial goods caches	Human remains Mortuary practices Cultural affiliation Morphological and stylistic data Pigment dating Radiocarbon dating	Heat spalling of rock surface Vegetation growth contacting features Heavy ground disturbance Smoke blackening	Avoid ground disturbance Suppression	Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
INDIGENOUS AMERICAN POPULATIONS: Post-Archaic and Pre-Contact Developments: Intercultural Relations Between Southern Plains and Northern Mexico	Campsites containing constructed shelter: Stone enclosures; wickiups	Stacked stone walls Boulder metates Interior and exterior cooking hearths Lithic concentrations Artifact caches	Chronological and functional data Feature/structure integrity Cultural affiliation Radiocarbon data contamination	Heat spalling of rock surfaces; Vegetation growth contacting features; Smoke blackening; Radiocarbon data contamination; Temperatures >500 C	Avoid ground disturbance	Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
INDIGENOUS AMERICAN POPULATIONS: Contact Period - Post AD 1550	Campsites containing constructed shelter: Stone enclosures, wickiups	Stacked stone walls Boulder metates Interior and exterior cooking hearths Lithic concentrations Artifact caches	Chronological and functional data Feature/structure integrity Cultural affiliation Radiocarbon data contamination	Heat spalling of rock surfaces; Vegetation growth contacting features; Smoke blackening; Radiocarbon data contamination; Temperatures >500 C	Avoid ground disturbance	Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
	Rock Art	Red linear pictographs Depictions of horseback riders	Chronological and functional data Morphological and stylistic data Interpretive value Pigment dating	Heat spalling of rock surface Vegetation growth contacting features Smoke blackening Heat alteration of biotic/mineralogic surface coatings	Suppression	Manual fuel reduction

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Historic Context	Resource Type	Elements	Elements or Values at Risk	Risk Conditions	Management Objectives	Treatment or Prescriptions
	Open Campsites	Stone-lined hearths Burned earth surfaces Metal artifacts Ceramic artifacts	Chronological and functional data Feature integrity Diagnostic artifacts	Foot traffic Fireline construction Moderate to high intensity/residence fire? Ground disturbance Chemical retardant drops Vegetation growth contacting features Radiocarbon data contamination Temperatures >500 C	Avoid ground disturbance	Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
EUROPEAN/ AMERICAN EXPLORATION AND SETTLEMENT, 1848- 1890: The Camel Expeditions by the Topographic Corps of Engineers	Landmarks along the routes of the 1859-1860 expeditions	Comanche Trail Campsites at springs and waterholes Glass and metal artifacts	Chronological and functional data Heat damage to solder seams on metal containers, coatings on military insignia	Temperatures >135 C	Avoid ground disturbance	Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
POLITICAL AND MILITARY AFFAIRS, 1865-1939	Neville Spring Black/Seminole Indian Scout Outpost	Officers Quarters ruin Enlisted Barracks ruin Blacksmith area with metal artifacts Outlier observation posts	Chronological and functional data Heat damage to solder seams on metal containers, coatings on military insignia	Heat spalling of rock Heat spalling of mortar Temperatures >135 C	Avoid ground disturbance	Manual fuel reduction around burnable structures and features; Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
	Military outlier lookout posts	Stone enclosures Trash dumps	Chronological and functional data Heat damage to solder seams on metal containers, coatings on military insignia	Temperatures >135 C	Avoid ground disturbance	Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
	La Noria Cavalry Camp	Stone alignments Trash dumps	Chronological and functional data Heat damage to solder seams on metal containers, coatings on military insignia Stone alignments defining parade ground Artifacts in trash dumps and on ground surface	Fireline construction Temperatures >135 C	Avoid ground disturbance	Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
	Glenn Springs Cavalry Camp	Stone alignments/ and foundations Metal artifacts Rifle pits/machine gun emplacements Trash dumps	Chronological and functional data Heat damage to solder seams on metal containers, coatings on military insignia Stone alignments defining parade ground and Gary Owen insignia Artifacts in trash dumps and on ground surface	Foot traffic Fireline construction Temperatures >135 C	Avoid ground disturbance	Manual fuel reduction around burnable structures and features; Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation

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Historic Context	Resource Type	Elements	Elements or Values at Risk	Risk Conditions	Management Objectives	Treatment or Prescriptions
	Johnson Ranch Airfield	Runway Building ruins and foundations Trash dumps Cemetery	Chronological and functional data Metal, glass, & ceramic artifacts Wooden grave markers and delineators	Melting of non-ferrous metal, glass, ceramic Temperatures > 232 C	Avoid ground disturbance	Manual fuel reduction around burnable structures and features; Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
	Camp Santa Helena (Castolon)	Buildings Historic artifact scatters	Chronological and functional data Interpretive value Commercial value (store) Govt. property value (storage) Structural integrity	Temperatures > 232 C	Avoid ground disturbance Suppression	Manual fuel reduction around burnable structures and features; Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
WESTWARD EXPANSION OF THE UNITED STATES, 1763-1898: The Cattleman's Empire: Ranches	G-4 Ranch / Gano Ranch Site	Building foundations Trash piles Household objects Fence lines, corrals	Wooden structural elements Glass and ceramic artifacts	Temperatures >135 C	Avoid ground disturbance	Manual fuel reduction around burnable structures and features; Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
RANCHING: 1880-1944	Ranching sites: Homer Wilson Blue Creek Line Camp, Sam Nail Ranch, K-Bar Ranch, Buttrill Ranch, Rice Ranch, Other ranches	Stone, adobe, wood frame buildings Building foundations Stone ruins Adobe ruins Wooden framing elements Trash Piles Vegetative plantings Fence lines, corrals Masonry dams Earthen dams and stock ponds Waterlines and windmills Water storage structures Family cemeteries	Interpretive value Structural integrity Wooden structural elements Non-ferrous metal, glass, ceramic artifacts Wooden, glass, ceramic funerary objects	Temperatures > 232 C	Avoid ground disturbance Suppression Avoid loss of physical patterning of corrals, fencelines, etc.	Manual fuel reduction around burnable structures and features; Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
AGRICULTURE: Flood Plain Farming: Adaptations of the Spanish Acequia Farming System and Indigenous Farming Methodology	Terlingua Abajo community site	Stone ruins Adobe ruins Wooden framing elements Trash Piles Irrigation structures Earthen berms and diversion structures Brick Kiln Cemetery Church Threshing floor	Interpretive value Structural integrity Wooden structural elements Non-ferrous metal, glass, ceramic artifacts Wooden, glass, ceramic funerary objects	Temperatures >135 C	Avoid ground disturbance	Manual fuel reduction around burnable structures and features; Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation

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Historic Context	Resource Type	Elements	Elements or Values at Risk	Risk Conditions	Management Objectives	Treatment or Prescriptions
	Luna Jacal	Rock structure Ocotillo / earth roofing Unmarked family graves Earthen berms and diversion structures	Structural integrity Wooden structural elements	Temperatures > 232 C	Avoid ground disturbance	Manual fuel reduction around burnable structures and features; Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
	La Coyota Community	Stone ruins Adobe ruins Wooden framing elements Trash Piles Irrigation structures Earthen berms and diversion structures Cemetery	Structural integrity Wooden structural elements Non-ferrous metal, glass, ceramic artifacts Wooden, glass, ceramic funerary objects	Temperatures > 232 C	Avoid ground disturbance Suppression Community map needed	Manual fuel reduction around burnable structures and features; Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
	San Vicente Community	Stone ruins Adobe ruins Wooden framing elements Trash Piles Irrigation structures Earthen berms and diversion structures Cemetery	Structural integrity Wooden structural elements Non-ferrous metal, glass, ceramic artifacts Wooden, glass, ceramic funerary objects	Temperatures > 232 C	Avoid ground disturbance Community map needed	Manual fuel reduction around burnable structures and features; Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
BUSINESS: The Candelilla Wax Industry	Wax camps and wax factories	Fireboxes Firebox pits Wax vats Wax strainers Sleeping shelters	Structural integrity Wooden structural elements Non-ferrous metal, glass, ceramic artifacts	Temperatures > 232 C	Avoid ground disturbance	Manual fuel reduction around burnable structures and features; Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
COMMUNICATION	Telegraph and telephone lines	Wooden poles Glass insulators Wire	Wooden fixtures Patination surface on insulators	Temperatures > 232 C	Avoid ground disturbance	Manual fuel reduction around burnable structures and features
ARCHITECTURE: Vernacular Architecture:	Indigenous construction in remote frontier locations	Jacal structures, Dugouts, Adobe and rock masonry residential structures, Outbuildings, Masonry dams	Structural integrity Unique wooden structural elements Non-ferrous metal, glass, ceramic artifacts Wooden, glass, ceramic funerary objects	Temperatures > 232 C	Avoid ground disturbance Suppression on structures with combustible elements	Manual fuel reduction around burnable structures and features Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
ARCHITECTURE: Rustic Architecture:	Civilian Conservation Corps	Stone cottages Rock masonry headwalls, retaining walls, and buttress walls on roads and trails	Commercial value (lodging) Interpretive value Wooden structural elements	Heat spalling of plasters Blistering of painted surfaces Electrical utility lines Temperatures > 135 C	Avoid ground disturbance Suppression on structures with combustible elements	Manual fuel reduction around burnable structures and features; Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
TECHNOLOGY:	Mining and mineral	Shafts and adits	Interpretive value	Temperatures > 135 C	Avoid ground	Manual fuel reduction around

Big Bend National Park Cultural Resources at Risk from Fire

Historic Context	Resource Type	Elements	Elements or Values at Risk	Risk Conditions	Management Objectives	Treatment or Prescriptions
Extraction of Raw Materials	extraction and processing	Rail transfer system Equipment mounting platforms Loading chutes Retorts Condensers Management infrastructure buildings Community structures Cemetery Trash piles	Structural integrity Wooden structural elements Non-ferrous metal, glass, ceramic artifacts Wooden, glass, ceramic funerary objects		disturbance Suppression on structures with combustible elements Prevent fire from falling into mine shafts	burnable structures and features; Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
TRANSPORTATION: American Indian travel routes	Comanche Trail, river crossings, routes through major terrain features	Entrenched trail at stream crossings Vegetation pattern defines trail	Loss of defining vegetation pattern	Moderate intensity fire	Avoid ground disturbance	Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
TRANSPORTATION: Mining	Puerto Rico Ore Tramway, Ore Road, Mariscal Mine haul road	Tramway towers Terminal ruin Cable Ore buckets	Interpretive value Wooden structural elements	Temperatures > 50 C	Avoid ground disturbance Suppression on structures with combustible elements	Manual fuel reduction around burnable structures and features; Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
TRANSPORTATION: 19 th and 20 th Century Travel Routes	Pre-Park road system, NPS open roads	Roadbed Roadside debris Bridge ruins Highway camps	Non-ferrous metal, glass, ceramic artifacts	Temperatures > 135 C	Avoid ground disturbance	Avoid highway camps and trash piles; Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
TRANSPORTATION: C.C.C. Road Construction	Road alignment Bridges & culverts	Original vertical and horizontal alignment Stone masonry	Scenic entry into park Interpretive value Structural integrity	Heat spalling of mortar joints on road culverts/trail structures	Avoid ground disturbance	Manual fuel reduction around masonry structures; Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
RELIGION: American Indian Ceremonial Practices	Vision Quest Sites, Calendric Sites, Medicine Wheels	Stone enclosures Stone alignments Commemorative cairns Burial cairns	Integrity of stone alignments, cairns, and enclosure walls		Avoid ground disturbance	Manual fuel reduction Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation
RELIGION: Euro-American Religious Practices	Churches, Private Chapels, Matachine Sites, Cemeteries	Foundations and walls Wooden framing elements Wooden crosses Glass and ceramic offering objects	Interpretive value Non-ferrous metal, glass, ceramic artifacts	Temperatures > 135 C	Avoid ground disturbance Suppression on structures with combustible elements	Manual fuel reduction around burnable structures and features; Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation

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Historic Context	Resource Type	Elements	Elements or Values at Risk	Risk Conditions	Management Objectives	Treatment or Prescriptions
EDUCATION: Special Populations: Frontier Schools	School buildings and sites	Foundations Walls Trash piles	Interpretive value Non-ferrous metal, glass, ceramic artifacts	Temperatures > 232 C	Avoid ground disturbance	Manual fuel reduction around burnable structures and features; Pretreatment: hand lines/ring firing; use water where possible to suppress; photo documentation

Appendix D. Plant and Animal Species referred to in this EA

Acorn woodpecker (*Melanerpes formicivorus*)
Alkali sacaton (*Sporobolus airoides*)
Alligator juniper (*Juniperus deppeana*)
Arizona cypress (*Cupressus arizonica*)
Beaver (*Castor canadensis*)
Bear grass or Sacahuista (*Nolina microcarpa*)
Beebrush (*Aloysia gratissima*)
Bermuda grass (*Cynodon dactylon*)
Big Bend gambusia (*Gambusia gaigei*)
Bighorn desert sheep (*Ovis canadensis* spp.)
Bigpod bonamia (*Bonamia ovalifolia*)
Bigtooth maple (*Acer grandidentatum*)
Black bear (*Ursus americanus mexicanus*)
Black-capped vireo (*Vireo atricapilla*)
Black grama (*Bouteloua eriopoda*)
Black phoebe (*Sayornis nigricans*)
Black-tailed jackrabbit (*Lepus californicus*)
Black-tailed rattlesnake (*Crotalus molossus*)
Blue grama (*Bouteloua gracilis*)
Bobcat (*Lynx rufus*)
Broadtail hummingbirds (*Selasphorus platycercus*)
Buffelgrass (*Pennisetum cilare*)
Bull muhly (*Muhlenbergia emersleyi*)
Bunched cory cactus (*Coryphantha ramillosa*)
Bushtits (*Psaltriparus minimus*)
Cactus wren (*Campylorhynchus brunneicapillus*)
California cottontop (*Digitaria californica*)
Candelilla (*Euphorbia antisyphilitica*)
Catclaw Acacia (*Acacia constricta*)
Catclaw Mimosa (*Mimosa aculeaticarpa* var. *biuncifera*)
Ceniza (*Leucophyllum minus*)
Chino grama (*Bouteloua breviseta*)
Chisos agave (*Agave glomeruliflora*)
Chisos coral root (*Hexalectris revolute*)
Chisos hophornbeam (*Ostrya chisosensis*)
Chisos metalmark (*Apodemia chisosensis*)
Chisos Mountain or Lateleaf oak (*Quercus tardifolia*)
Chisos Mountain hedgehog cactus (*Echinocereus chisoensis* var. *chisoensis*)
Chisos pinweed (*Lechea mensalis*)
Chaffey's cory cactus (*Escobaria* var. *chaffeyi*)
Coachwhip snake (*Masticophis flagellum*)
Coahuila oak (*Quercus polymorpha*)
Colima warbler (*Streptanthus cutleri*)
Common black hawk (*Buteogallus anthracinus*)
Common reed (*Phragmites australis*)
Cottonwood (*Populus deltoides* var. *fremontii*)
Coyote (*Canis latrans*)
Creosote (*Larrea tridentata*)
Curve-billed thrasher (*Toxostoma curvirostre*)
Cutler's Twistflower (*Streptanthus cutleri*)

Dalea spp. (approximately 12 species)
 Deer muhly (*Muhlenbergia rigens*)
 Dense cory cactus (*Escobaria dasyacantha* var. *dasyacantha*)
 Desert willow (*Chiloensis linearis*)
 Dog cholla (*Opuntia schottii*)
 Douglas fir (*Pseudotsuga menziesii*)
 Duncan's cory cactus (*Coryphantha duncanii*)
 Elf owls (*Micrathene whitneyi*)
 Emory oak (*Quercus emoryi*)
 Evergreen sumac (*Rhus virens* var. *choriophylla*)
 Fragrant ash (*Fraxinus cuspidata*)
 Giantreed (*Arundo donax*)
 Glass Mountain coral root (*Hexalectrus nitida*)
 Gnatcatchers (*Polioptila caerulea*)
 Golden eagle (*Aquila chrysaetos*)
 Golden-spined prickly pear (*Opuntia aureispina*)
 Graves oak (*Quercus gravesii*)
 Gray breasted jay (*Aphelocoma ultramarina*)
 Gray fox (*Urocyon cinereoargenteus*)
 Gray hawk (*Asturina plagiata*)
 Gray oak (*Quercus grisea*)
 Greater western mastiff bat (*Eumops perotis californicus*)
 Green sprangletop (*Lepochloa dubia*)
 Guayacan (*Guaiacum angustifolium*)
 Guadalupe fescue (*Festuca ligulata*)
 Hairy grama (*Bouteloua hirsuta*)
 Harvard agave (*Agave harvardiana*)
 Harvard's stonecrop (*Sedum harvardii*)
 Harvard plum (*Prunus harvardii*)
 Hetchia or falseagave (*Hechtia texensis*)
 Hinckley's oak (*Quercus hinckleyi*)
 Javalina (*Pecari tajacu*)
 Johnson grass (*Sorghum halepense*)
 Leatherstem (*Jatropha dioica*)
 Lechuguilla (*Agave lechuguilla*)
 Lehmanns lovegrass (*Eragrostis lehmanniana*)
 Little-leaf brogniartia (*Brogniartia minutifolia*)
 Lloyd's Mariposa cactus (*Sclerocactus mariposensis*)
 Loggerhead shrike (*Lanius ludovicianus*)
 Long-spur colombine (*Aquilegia longissima*)
 Lovegrass (*Eragrostis* spp.)
 Mariola (*Parthenium incanum*)
 Mesquite (*Prosopis glandulosa*)
 Mexican buckeye (*Ungnadia speciosa*)
 Mexican gray wolf (*Canis lupus baileyi*)
 Mexican long-nosed bat (*Leptonycteris nivalis*)
 Mexican pinyon (*Pinus cembroides*)
 Mexican spadefoot toad (*Spea multiplicata*)
 Mockingbird (*Mimus polyglottos*)
 Mountain lion (*Puma concolor*)
 Mountain mahogany (*Cercocarpus montanus*)
 Mule deer (*Odocoileus hemionus*)

Netleaf oak (*Quercus rugosa*)
 Northern Aplomado falcon (*Falco femoralis septentrionalis*)
 Northern flicker (*Colaptes auratus*)
 Ocotillo (*Fouquieria splendens*)
 Peregrine falcon (*Falco peregrinus*)
 Pinyon ricegrass (*Pipochaetum fimbriatum*)
 Ponderosa pine (*Pinus ponderosa*)
 Prickly pear (*Opuntia* spp.)
 Puckering nightshade (*Nectouxia formosa*)
 Purple gay mallow (*Batesimalva violacea*)
 Redberry juniper (*Juniperus pinchottii*)
 Red oak (*Quercus rubra*)
 Resurrection fern (*Selaginella lepidophylla*)
 Rio Grande leopard frog (*Rana berlandieri*)
 Roadrunner (*Geococcyx californianus*)
 Robert's stonecrop (*Sedum robertsianum*)
 Rock Squirrel (*Spermophilus variegates*)
 Rufous towhe (*Pipilo erythrophthalmus*)
 Russian thistle (*Salsola kali*)
 Saltcedar (*Tamarix ramossissima*)
 Scotts oriele (*Icterus parisorum*)
 Screech owls (*Otus asio*)
 Screwbean (*Prosopis pubescens*)
 Scrub Oak (*Quercus turbinella*)
 Sea urchin cactus (*Echinocactus asterias*)
 Shorthorn jefea (*Jefea brevifolia*)
 Shrubby groundsel (*Baccharis halimifolia*)
 Sideoats grama (*Bouteloua curtipendula*)
 Sierra del Carmen oak (*Quercus carmenensis*)
 Sierra del Carmen whitetail deer (*Odocoileus virginianus*)
 Silver-spined cholla (*Opuntia imbricata* var. *argentea*)
 Skeletonleaf goldeneye (*Viguiera stenoloba*)
 Slender Oak or Chisos oak (*Quercus graciliformis*)
 Slimleaf vauquilinia (*Vauquelinia corymbosa* subsp. *angustifolia*)
 Southwestern willow flycatcher (*Empidonax traillii extimus*)
 Sotol (*Dasyilirion wheeleri*)
 Swallow spurge (*Chamaesyce golondrina*)
 Tall-stemmed paintbrush or Squawflower (*Castilleja elongata* or *C. integra* var. *integra*, taxonomy questionable)
 Tarbush (*Flourensia cernua*)
 Texas antelope (*Antilocapra americana* and *A. mexicana*)
 Texas hornshell (*Popenaias popei*)
 Texas horned lizard (*Phrynosoma cornutum*)
 Texas largeseed bittercress (*Cardamine macrocarpa* var. *texana*)
 Texas madrone (*Arbutus xalapensis [texana]*)
 Texas persimmon (*Diospyros texana*)
 Texas purple spike (*Hexalectris warnockii*)
 Three-awns (*Aristida* spp.)
 Three-tongued spurge (*Chamaesyce chaetocalyx* var. *triligulata*)
 Tobosagrass (*Hilaria mutica*)
 Trans-Pecos maidenbush (*Andrachne arida*)
 Trans-Pecos rat snake (*Bogertophis subocularis*)

Striped Skunk (*Mephitis mephiis*)
Turkey vulture (*Cathartes aura*)
Two-Bristle rock daisy (*Perityle bisetosa* var. *bisetosa*)
Variable oakleaf caterpillar (*Lochmaeus manteo*)
Slimleaf rosewood (*Vauquelinia corymbosa* var. *heterodon*)
Weeping juniper (*Juniperus flaccidus*)
Western diamondback rattlesnake (*Crotalus atrox*)
Western pipistrelle (*Pipistrellus Hesperus*)
White column cactus (*Escobaria albicolumnaria*)
Willow, Goodding (*Salix gooddingii*), Black (*S. nigra*), Coyote (*S. exigua*)
Wright silktassel (*Garrya wrightii*)
Yellow bells (*Tacoma stans*)
Yellow-billed cuckoo (*Coccyzus americanus*)
Yellow-breasted chat (*Icteria virens auricollis*)
Yellow-nosed cotton rat (*Sigmodon ochrognathus*)
Yucca (6 *Yucca* spp.)

Appendix E: Watershed areas and potential impacts following high-severity fire

Soils Mapping Unit	Watersheds	Area (Approx)	Soil Characteristics	Slope % (mostly)	Vegetation	Susceptibility to erosion & debris flows following high-intensity, widespread fire
BRG Brewster Rock Outcrop Complex Very Steep	Around the west and north sides of the Basin.		Shallow to very shallow well-drained soils formed on rolling to very steep igneous mountains with rock outcrops. About 1/3 of the soil is clay, with cobbles and gravel making up 35-70% of the soil volume.	20-45 some vertical walls.	Vegetation in rock fissures and lower slopes. Includes Mexican pinyon pine, juniper, oaks, with shrubby Texas Madrone, mountain mahogany, evergreen sumac, littleleaf sumac, skeletonleaf goldeneye, and grasses sideoats grama, cane bluestem and threeawns.	Water erosion and debris flows are a hazard with steep slopes, shallow depth to bedrock (4-20 inches) and a clay layer slowing infiltration. Cobbles and gravel together with grass cover reduce surface erosion on some areas.
LMF –Liv Mainstay Rock Outcrop Complex Steep	South of trail to Laguna Meadows to Chisos Basin		Liv soils are deep (60-80 inches), well drained, moderately slowly permeable soils formed in clayey cobbly and gravelly materials over igneous bedrock. Mainstay soils are shallow (10 20 inches), well-drained on uplands Gravelly or cobbly with 35-80% coarse fragments by volume.	2-45	On Liv soils vegetation is grass with some areas having an overstory of oaks, junipers and pinion pines. Grasses are mainly grama, bluestem, muhly, and threeawn. Mainstay soils support Pinyon pine, oaks, junipers, Texas Madrone, bigtooth maple, sumacs, semi-succulents and grasses.	About 40 inches to bedrock and 35-60% by volume of cobbles and gravel. Surface runoff is rapid and permeability moderately slow. With steep slopes water erosion is a severe hazard. Debris flows likely. Surface runoff is rapid and permeability moderately slow. Rooting depth is shallow to less than 20 inches to bedrock. Water erosion is a severe hazard because of steep slopes. Debris flows likely.
PRF Puerta Madrone Complex Steep			Shallow and moderately deep, steep, very gravelly soils over 6000 ft.	20-45	Pinyon pine, oaks, Arizona Cypress with Ponderosa pine and Douglas fir on north slopes and canyon bottoms.	Puerta soils are ~50% of the unit and have rapid runoff and gravelly, silty loam to bedrock at 20 inches. Madrone soils are ~35% more permeable in the upper layers with clayey soils at bedrock ~32 inches.
ERF Ector – Rock Complex Steep	SW of Laguna Meadow		Shallow or very shallow, well drained soils that are moderately permeable above a very slowly	Up to 60		Depth to underlying limestone bedrock is 6-20 inches. Very slowly permeable and well drained. Runoff

			permeable limestone bedrock. They formed in loamy residuum. Cobbles make up 0-20% of soil volume			very high on slopes over 5% Erosion Low Debris flows:Low
HRF- Hurds Very Cobbly Loam Steep	Green Gulch Pine Canyon ?		Deep, very gravelly and very cobbly well-drained soils on igneous hills and mountains at 5,000-6,000ft.	20-45	Mexican pinyon pine, redberry juniper, gambel oak, catclaw, catclaw and foothill basketgrass, Mexican sagewort, wolftail, deer muhly, bracken fern, little bluestem, hairy grama and cane bluestem.	Although these soils are deep ~60 inches and well drained, low water holding capacity and steep slopes make water erosion a severe hazard. Debris flowsLow
HRD - Hurds Very Gravelly Sandy Loam Rolling	Green Gulch Pine Canyon bottom of slopes		Deep, very gravelly soils in valleys and foot of slopes from 4,500-5,600 feet.	3-20	Mexican buckeye, foothills basetgrass, littleleaf leadtree, Apacheplume, juniper, sotol, catclaw, agave, hairy grama little bluestem and cane bluestem.	These soils are well drained deep and and moderately permeable. Water holding capacity is low and slopes are moderate making water erosion a moderate hazard. Debris flows: Low

Table compiled from Soil Survey of Big Bend National Park (1985), and USDA Official Soil Series Descriptions (on line, April 2004).

Soil Mapping Unit: An area of the landscape where soils have the same or similar characteristics (Buol et al, 1997).

Watersheds, Slopes and Acres: Supplied by Jeffrey Bennett park hydrologist, April, 2004

Watershed	Acres (approximate)	% slope-highest elevation in watershed	% slope-middle elevation in watershed	% slope-lowest elevation in watershed
Green Gulch	2367	100	68	6.7
Northwest Undifferentiated	424			
Oak Canyon	3804	223	51	6
Boot Canyon	845	100	35	20
Juniper Canyon	3136	100	50	5.7
Cattail Canyon	1487	42	51	80
Western Undifferentiated	866			
Pine Canyon	3189	165	51	7.5
Northeast Undifferentiated	2797			
Blue Creek Canyon	1143	200	40	20
South rim Undifferentiated	1202			

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3. Buol, S.W., F.D. Hole, R.J. McCracken and R.J. S. 1997. *Soil Genesis and Classification*. Fourth Edition. Iowa State University Press.
4. Lynn Loomis: Soil Scientist, USDA- NRCS, Mar
5. Jeff Bennett: Hydrologist/ geologist, Big Bend N



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SEP 20 2005

John H. King *JK*
Superintendent
Big Bend National Park
P.O. Box 129
Big Bend National Park, Texas 79834-0129

Consultation # 2-15-2000-F-0572

Dear Mr. King:

Enclosed is a copy of the final Biological Opinion for the proposed Big Bend National Park Fire Management Plan in Brewster County, Texas.

Thank you for your assistance and quick response for completing this document, and we look forward to working with you and your staff on future projects. If you have any questions regarding this Biological Opinion, please contact Jana Milliken at 512-490-0057, extension 243.

Sincerely,

Robert T. Pine

Robert T. Pine
Supervisor

Enclosure

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SEP 20 2005

John H. King
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Big Bend National Park
P.O. Box 129
Big Bend National Park, Texas 79834-0129

Consultation # 2-15-00-F-0572

Dear Mr. King:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of the proposed June 2005 Fire Management Plan (FMP) for the National Park Service's (NPS) Big Bend National Park (BBNP) located in Brewster County, Texas, and its effects on the black-capped vireo (*Vireo atricapilla*), Chisos Mountain hedgehog cactus (*Echinocereus chisoensis* (= *reichenbachii*) var. *chisoensis*), and the Mexican long-nosed bat (*Leptonycteris nivalis*) in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act)(16 U.S.C. 1531 et seq.). Your June 1, 2005, request for formal consultation was received on June 3, 2005.

BBNP determined, and the Service concurs, that the bunched cory cactus (*Coryphantha ramillosa*), Lloyd's Mariposa cactus (*Neolloydia mariposensis*), southwestern willow flycatcher (*Empidonax traillii extimus*), northern aplomado falcon (*Falco femoralis septentrionalis*), and Big Bend gambusia (*Gambusia gaigei*) may be affected, but are not likely adversely affected, by the proposed project.

This biological opinion is based on the June 2005 Biological Assessment (BA) for the FMP, the Environmental Assessment (EA) for the FMP, telephone conversations, site visits, and other sources of information. A complete administrative record is on file at this office.

Consultation History

- April 13, 2000: The Service wrote BBNP's March 8, 2000, information and species request.
- October 4, 2000: The Service letter to BBNP with concerns for four prescribed fire projects.
- September 19, 2002: The Service responded to the August 13, 2002, EA on the Management Ignited Prescribed Burns for 2002-2003.
- October 16, 2002: Phone conversation with BBNP fire staff about a "Finding of No Significant Impact (FONSI)."



- June 2003: Site visit to BBNP by Service biologists Jana Milliken, Paige Najvar, Tim Schumann, and Robert Pine.
- November 13, 2003: BBNP letter outlined the five-year FMP. A series of e-mails followed between Jana Milliken (Service) and Susan Moodie (University of Arizona), who was contracted to write the BA.
- April 1, 2004: An updated Brewster County species list was faxed to Susan Moodie.
- April 13, 2004: The Service met with BBNP staff to discuss the section 7 consultation process on the FMP.
- April 20, 2004: Phone conversation between the Service, Susan Moodie and Raymond Skyles determined that prescribed burns in known black-capped vireo habitat would be avoided.
- April 26, 2004: The Service provided comments on the draft BA.
- July 23, 2004: The Service provided comments on the black-capped vireo section of the BA.

BIOLOGICAL OPINION

Proposed Action

The NPS is updating their 1994 FMP to reflect advances in knowledge of fire ecology and NPS policy. The FMP ultimately should reduce the need for prescribed fire and allow wildfire to restore BBNP's historical vegetation structure. Drought, grazing, and fire suppression have resulted in high fuel load buildup, particularly in the Chisos Mountains that lie along the west side of the center of BBNP. The careful use of prescribed fire and non-suppression of wildfire in low-risk areas are planned to reduce the risk of catastrophic wildfire. The FMP proposed burning schedule is from 2004-2012; this Biological Opinion addresses burning from the remainder of 2005 (from the date of this Biological Opinion) through 2012.

The FMP divides BBNP into two fire management units (FMUs) (Figure 1). FMU #1 includes buildings and other structures, cultural resource sites, federally listed species locations, and a 1.6-kilometer (1-mile) buffer around the park boundary. BBNP plans to work with neighboring landowners to reduce the buffer to allow fire to burn to existing natural or man made boundaries, such as rivers, roads, bare areas, and cliffs. Prescribed fire, fuel reduction treatments without the use of fire, and allowance of wildfire that does not exceed wind and moisture limits will all be permitted in FMU #1. FMU #2 includes the rest of BBNP. Wildfires will be allowed to burn uncontrolled in this unit as long as they do not exceed wind and moisture limits, to allow safe and ecologically effective burns.

In addition, FMU #2 includes the Chisos Basin, a valley near the center of the park, as a special treatment zone. The Basin will be allowed to burn within prescriptions and be monitored very closely. Research burns are planned in the Basin to study the effects of fire on sensitive species, including the black-capped vireo, Chisos Mountain hedgehog cactus, and the Mexican long-nosed bat (Figure 2). These burns will be introduced on a limited level, and depending on the

results, fire may be used to achieve management objectives on a wider scale. Specifically, these burns may answer questions related to the adaptability of black-capped vireos to burned areas.

The only site in the U.S. known to contain the candidate species Guadalupe fescue (*Festuca ligulata*) is located in Boot Canyon in the Chisos Basin. The population numbers about 500, and was previously addressed in a Candidate Conservation Agreement between NPS and the Service. Fire is being considered to remove duff over small areas (approximately 1 square meter [11 square feet]). Natural ignitions will be allowed in certain circumstances. The BA states that all prescribed fires in areas where Guadalupe fescue occur will be coordinated with the Service prior to burning.

The following conservation measures proposed by BBNP are summarized from the BA:

All species

- Firebreaks, staging areas, and spike camps will be in place in advance of fire to minimize disturbance.
- Areas impacted by fire will be rehabilitated by replanting, handbrushing lines, removing trash, and preventing erosion around habitat.

Black-capped vireo

- Researchers experienced with black-capped vireos will assess potential habitat and habitat management using fire.
- Conduct and study research burns exclusively outside of the breeding season.
- Avoid very small burns to reduce browsing pressure.
- Prevent burns from coming closer than 0.4 kilometers (0.25 miles) to vireo habitat to avoid breaking up territories and intrusion by brown-headed cowbirds (*Molothrus ater*), except at Green Gulch, in the center of the park, where burning is proposed to prevent damage from human-caused fires. A 100-meter (300-foot) break will be burned from the road in Green Gulch.
- Maintain a current map of occupied vireo habitat, to determine areas appropriate for prescribed fire and suppression or non-suppression of wildfire.
- Maintain close coordination between fire management and natural resource staff when planning prescribed burns in, or near, vireo habitat.
- Manually and/or mechanically remove ladder fuels in the Chisos Basin to reduce accidental fire and limit fire intensity.
- Establish permanent vegetation photo points to compare vegetation changes prior to fire or fuel management efforts.
- Proceed methodically, to allow data on plant succession (particularly in vireo habitat), and other research results to be accurately assessed.
- Develop a comprehensive black-capped vireo monitoring program to determine population dynamics and study why unoccupied areas remain unoccupied.

Chisos Mountain hedgehog cactus

- Buffelgrass (*Pennisetum ciliare*) will be removed by hand from around Chisos Mountain hedgehog cactus and along roadsides.
- Continue research with other scientists to better understand the genetics, reproductive biology, and habitat requirements of this species. Efforts are continuing between BBNP, Sul Ross State University, the Chihuahuan Desert Research Institute, and the Desert Botanical Garden in Phoenix, Arizona.
- A resource advisor (preferably a botanist) will be assigned to any fire (prescribed or wildfire) that may affect this species.
- No fire retardant drops will be allowed over habitat for the Chisos Mountain hedgehog cactus to prevent establishment of buffelgrass. Fire retardant may contain phosphate, which may serve as fertilizer for buffelgrass.
- Burned areas will be rehabilitated by recontouring soils, repositioning rocks, or planting additional plants.

Mexican long-nosed bat

- Eighty percent of agaves (*Agave* sp.) in the foraging range for the Mexican long-nosed bat will be maintained.
- Aircraft will not fly over Emory Cave when bats are present (June through August).
- A 0.4 kilometer (0.25 mile) buffer from fire will be retained downslope from Emory Cave.
- Fire retardant will not be dropped over Emory Cave except to save roosting bats during severe fires.
- High-fuel vegetation will be reduced around the entrance to Emory Cave to minimize the chance of fire entering the cave.
- Per recommendations in Howell (1996) and Johnson (2001), post-fire monitoring for agave survival/mortality will begin two years after any fire.
- Monitoring of populations in Emory Cave and demographic and feeding studies will take place as funding becomes available.

Status of the Species

Black-capped vireo

The black-capped vireo was federally listed as endangered in 1987 (52 FR 37420 - 37423). The vireo is a 11.4 centimeters (4.5 inches) long, insectivorous songbird. Mature males are olive green above and white below with faint greenish-yellow flanks. The crown and upper half of the head is black with a conspicuous white eye-ring. The iris is brownish-red and the bill is black. The mature females are generally duller in color than the males, and have a dark slate gray head (Service 1991).

Although vireo habitat throughout Texas is quite variable with respect to plant species, soils, and rainfall, habitat types generally have a similar overall appearance. Vireos typically inhabit patchy shrublands and open woodlands with a distinctive patchy structure in an early to mid-successional state, and are considered "disturbance dependent". The shrub vegetation structure generally extends from the ground to about 1.8 meters (6 feet) above ground and covers about 30 to 60 percent of the total area. In the Edwards Plateau, common plants in vireo habitat include Texas oak, shin oak (*Q. sinuata*), live oak, mountain laurel (*Sophora secundiflora*), sumac (*Rhus* sp), redbud (*Cercis canadensis* var. *texana*), Texas persimmon (*Diospyros texana*), mesquite (*Prosopis glandulosa*), and agarita (*Mahonia trifoliata*). Densities of Ashe juniper are usually low. In the Edwards Plateau, suitable habitat for the vireo is early successional scrub/shrub created by fire or woodland clearing. Vireos are opportunistic foragers, however, they prefer insect larvae and seeds (Grzybowski 1995). A description of breeding, nesting, and feeding characteristics can be found in Grzybowski 1995, Graber 1961, and Service 1991.

Vireos breed from Oklahoma south through central Texas and west to the Trans-Pecos and south to central Coahuila, Mexico (Graber 1961, Oberholser 1974, Farquhar 2005) and winter on the Pacific slope of Mexico. See Farquhar 2005 for description of vireo habitat and distribution in Mexico. By mid-September, vireos begin their migration south, beginning with females and young and followed by adult males (Graber 1957, Oberholser 1974).

Vireo populations have been extirpated in Kansas, and have been reduced in Oklahoma, suggesting habitat loss and parasitism by the brown-headed cowbird may be particularly prevalent in this part of the species' range (Grzybowski 1995). The Service (1991) lists the two main threats to this species as cowbird parasitism and suppression of natural processes, like fires.

No comprehensive population estimates for black-capped vireos have been done due to variable and incomplete sampling. Sexton et al. (1989) summarizes the historical status of the vireo in the Texas. Surveying for occurrence is limited by the ability to gain access to private property (Marshall et al. 1985). The Service is currently completing a comprehensive status review and expects to have a better understanding of black-capped vireo populations in Texas.

The recovery plan (Service 1991) divides the range into six regions in Texas and one each in Oklahoma and Mexico. In order to be reclassified from endangered to threatened, it calls for protection of: (1) sufficient habitat to support at least one self-sustaining population in four of the six Texas regions and one each in Oklahoma and Mexico, and (2) sufficient and sustainable area and habitat on the winter range exists to support the breeding population. The Service (1996) suggests a minimum population of 1,000 breeding pairs would be necessary to conserve one viable population with a low probability of extinction, and Hayden et al. (2001) suggests these pairs occupy about 4,166 hectares (10,290 acres). Currently, there are only four black-capped vireo populations receiving some degree of protection: Fort Hood Military Reservation in Bell and Coryell counties, Kerr Wildlife Management Area in Kerr County, Camp Bullis in Bexar County, and BBNP. Habitat protection and management to support populations must include elements of both breeding and non-breeding habitat, like associated uplands and migration corridors.

Population viability analyses on this species have indicated the most sensitive factors affecting their continued existence are brood parasitism by brown-headed cowbirds and loss and fragmentation of habitat, including certain range management practices, fire suppression, and urbanization (Service 1996).

Chisos Mountain hedgehog cactus

The Chisos Mountain hedgehog cactus was federally listed as endangered in 1988 (53 FR 38453 - 38456). Single, cylindrical stems are green to blue-green in the spring and summer, which turn reddish-maroon in the winter (Service 1993). Typically, this species grows to about 25 centimeters (10 inches) high. Spines are relatively sparse. The flower petals are deep red at the base and have white tips (Evans 1986). This species flowers from March to early June, and fruits from May to August (Heil and Anderson 1982b). The conspicuous fruits are fleshy and green-red (Heil and Anderson 1982a). Little else is known about the phenology or reproductive biology. A pollinator has not been identified (Heil and Anderson 1982a), and seed dispersal mechanisms are unknown.

The known range of this species in the U.S. is restricted to BBNP. Heil and Anderson (1982b) and Heil and Brack (1988) stated that the species had not been found in Mexico. However, Taylor (1985) and Anderson (2001) describe the distribution of the cactus as west Texas and south into Coahuila and Durango, Mexico. TPCC (2003) and Jackie Poole (Texas Parks and Wildlife Department, pers. comm. 2004) state the specimens in Mexico are of the variety *fobeanus*, not *chisoensis*.

This species is threatened by infestation of non-native buffelgrass, particularly along arroyos. Guertin and Halvorson (2004) found buffelgrass growing in proximity to the cactus, particularly on the north side of Route 12. While this species is normally not threatened by fire due to the lack of flammable fuel load in its typical habitat, buffelgrass is flammable, and there is concern that it could carry a fire and threaten individual cacti in close proximity. Typically, Chisos Mountain hedgehog cactus is found growing under creosote bush (*Larrea tridentate*) or among dog cholla (*Opuntia schottii*) (Kathy Rice, Desert Botanical Garden, pers. comm. 2005, Service 1988).

The recovery plan (Service 1993) cites illegal collecting as the most immediate threat to the Chisos Mountain hedgehog cactus. There is evidence that poaching of rare cactus species in BBNP is continuously occurring (Betty Alex 2005 and Mike Fleming 1993, Big Bend National Park, pers. comm.). Rees (1988) also speculates that habitat degradation from former grazing, climate change, or other unknown factors may be limiting seed establishment. The decline of grasses due to fire suppression and overgrazing may have resulted in the cactus becoming associated with "nurse plants" (Heil and Anderson 1982b, Service 1988). Delisting criteria in the recovery plan state that 50 distinct populations of at least 100 reproductive individuals are established within a minimum area of 4-8 hectares (10-20 acres). These populations must demonstrate stability and reproductive success over a period of at least 10 years (Service 1993).

Mexican long-nosed bat

The Mexican long-nosed bat was federally listed as endangered in 1988 (53 FR 38456 – 38460) by the U.S, and as endangered by Mexico in 1991. It is about 70-90 millimeters (2.75-3.75 inches) long, and weighs 18-30 grams (0.5-1.0 ounces) (Wilson 1985). The coloration is usually yellowish-brown or gray above, and cinnamon brown below (Service 1995). Diagnostic features which distinguish this species from the lesser long-nosed bat include a long snout and tongue, a short tail, and hairs extending beyond the edge of the interfemoral membrane (Service 1994). Hensley and Wilkins (1988) provides a complete species description.

The bat was first discovered in the U.S. in 1937 at Emory Cave, at an elevation of 2,286 meters (7,500 feet), in the Chisos Mountains in BBNP (Borell and Bryant 1942). This is the only known roosting location for this species in Texas, and the only known maternity roost site in the U.S. One other day roost site was discovered in 2004 in the Animas Mountains in Hidalgo County, New Mexico (Bogan et al. 2004). The numbers of Mexican long-nosed bats using Emory Cave fluctuates annually from zero to 13,650 (Davis and Schmidly 1994). This species has also been reported from the Chinati Mountains in Presidio County, Texas (Mollhagen 1973, Schmidly 1977) and New Mexico (Jones and Findley 1963), but no roost sites are known at either of these locations. This species is found in Emory Cave from June through August (Campbell 1995, Service 1995).

Mexican long-nosed bats are found in desert scrub vegetation containing agaves, mesquite (*Prosopis glandulosa*), and a variety of cacti. At BBNP, they are associated with (1) arroyo-mesquite-acacia at 549-1,219 meters (1,800-4,000 feet); (2) lechuguilla-creosotebush-cactus at 549-1,067 meters (1,800-3,500 feet); (3) deciduous woodland at 1,128-2,377 meters (3,700-7,800 feet); (4) pinyon-juniper-oak woodland at 1,128-2,377 meters (3,700-7,800 feet); and (5) cypress-pine-oak at 1,768-2,195 meters (5,800-7,200 feet) (Campbell 1995).

Peak years for this species in BBNP may be the result of low flower production of agaves in Mexico (Easterla 1972). These bats feed on agave nectar and cross-pollinate the flowers of the agave, resulting in a mutualistic relationship that both species depend on to survive (Davis and Schmidly 1994). Most of the agave populations in the Chisos Mountains occur above 1,200 meters (4,000 feet) in elevation (England et al. 2003). This species probably feeds on lechuguilla (*Agave lechuguilla*) at lower elevations, and century plants (*Agave harvardiana*) at higher elevations in the Chisos Mountains (Higginbotham and Ammerman 2002). Bat Conservation International (BCI) confirmed the existence of a “nectar corridor”, stretching approximately 530 kilometers (330 miles) from the El Infierno maternity roost in Nuevo Leon, Mexico to Emory Cave, which the Mexican long-nosed bat may use on its northward migration (England et al. 2003).

There are no records of pregnant females in Emory Cave (Schmidly 1977). It is thought that young are born April through June in central Mexico (Easterla 1972, Schmidly 1977) and migrate with their mothers to northern Mexico and southern Texas and New Mexico (Campbell 1995). The normal litter size is one (Davis 1974). Howell (1988) describes their wintering

grounds in central Mexico as a lush central valley which include the *Ipomoea* and *Ceiba* tree varieties.

A recent search by BCI for potential roost structures and caves in several mountain ranges of Texas, Coahuila, western Nuevo Leon, and Tamaulipas resulted in no new Mexican long-nosed bat roosts (England et al. 2003). The only known maternity roost in Mexico is the El Infierno Cave in Cumbres de Monterrey National Park in Nuevo Leon (Arnulfo Moreno-Valdez, Instituto Tecnológico de Cd. Victoria, pers. comm. 2005). Two roosts in Tamaulipas are proposed for protection by the Mexican government (Campbell 1995).

There are indications of substantial decline in numbers of this species (Campbell 1995, Schmidly 1991, Service 1994), although the species appears stable in Mexico (Arnulfo Moreno-Valdez pers. comm. 2005). Schmidly 1991 lists disturbance of roost sites, loss of agaves, and direct killing by humans (in Mexico) as primary threats. Other probable threats include pesticides, competition, natural catastrophes, disease, and predation (Service 1994). The Recovery Plan outlines downlisting criteria that at least six populations of Mexican long-nosed bats should be protected, one in each of six regions that encompass approximately 80 percent of the species range (Service 1994). BBNP occurs in the region that includes the Trans-Pecos of Texas, northern Coahuila, and eastern Chihuahua. All other regions are in Mexico, with one in western Chihuahua that extends into southwestern New Mexico.

Environmental Baseline

The environmental baseline includes past and ongoing impacts of all Federal, State, or private actions in the action area, the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation, and the impact of state and private actions which are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a basis to assess the effects of the FMP.

The Service recognizes the action area (the area that may be directly or indirectly affected by the proposed action) to be BBNP and a 1.6-kilometer (1 mile) buffer around the boundary to account for effects from smoke and uncontrolled fire that may cross the park boundary.

Status of the species within the action area:

Black-capped vireo

This species was first reported at BBNP by Cruickshank (1950), and the first documented breeding was by Barlow (1967). Surveys have been conducted at BBNP since 1986. Vireos have been found in Juniper Canyon, Pine Canyon, Green Gulch, Blue Creek Ranch, Casa Grande, Panther Canyon, Laguna Meadows, and the Chisos Basin (Figure 3). Casa Grande, the Chisos Basin, and Blue Creek Ranch contain portions of FMU #1. The remaining vireo habitat

is in FMU #2. Habitat in BBNP appears to be “static”, and reliant on soil factors and drier conditions (Farquhar and Maresh 1996).

Cornelius (2004) reported his impression that available habitat is not a limiting factor on black-capped vireos at BBNP, and that there are small but suitable habitat patches that are not occupied. Cornelius shows that at Fort Hood this species will readily relocate in response to disturbance. However, whether vireos will relocate to unoccupied areas in response to a fire is unclear. In addition, Armstrong (Kerr Wildlife Management Area, pers. comm. 2004) noted that due to the ruggedness of the terrain, there are probably areas of vireo habitat that are not being monitored.

The following is a summary of survey results from Maresh 2005:

Year	Territories	Nests	# fledged	Source
2000 ¹	7	?	?	Peck and Barlow 2000
2001	3	1	0	Maresh and Rowell 2001
2002	4	2	3-4	Maresh and Rowell 2002
2003	7	2	2-3	Maresh 2003
2004	11	3	5-6	Maresh 2004

In 2005, a total of 8 males and 1 female were detected in Pine Canyon, Juniper Canyon, and Green Gulch (Service 2005).

Chisos Mountain hedgehog cactus

Previous surveys of this species are detailed in Evans (1986), Alex and Norland (1987), and Norland (1987). The BA lists the cactus currently occurring in 12 populations with a total of about 1,000 plants in a 48-square kilometer (30-square mile) area within the park. The Texas Biological Conservation Data System (TBCD 2005) lists 12 element of occurrence records for this species, all within BBNP. All known cactus locations and habitat are located within FMU 2.

It appears that known populations in BBNP are declining (Heil and Anderson 1982a, Poole 1987). In accordance with the criteria outlined in the Recovery Plan, reintroduction efforts were initiated in BBNP in 2004 (Service 1993). To date, 560 seedlings and over 12,000 seeds were distributed, with an approximate survival rate of 30 percent.

Mexican long-nosed bat

Easterla 1972 provides a summary of surveys of Emory Cave since 1937. England et al. (2003) provides the following summary of surveys of Emory Cave:

- 2001: 3,000-5,000 Mexican long-nosed bats in the visually accessible portions;

¹ Surveys were completed prior to completion of nesting period. One nest with a pair incubating eggs was discovered, but the others had just started laying, were still building nests, or possibly had abandoned their nests.

- 2002: None seen, but an undetermined number heard in the inaccessible portions;
- 2003: This species was positively identified among 50-75 bats emerging, but an approximate number of Mexican long-nosed bats was not provided.

Effects of the Action

Effects of the action refer to direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated and interdependent with that action that will be added to the environmental baseline. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur.

There are no previous formal consultation or endangered species take permits issued in the action area. Two prescribed fires at BBNP have escaped in the past: at Casa Grande in the Chisos Basin, burning approximately 93 hectares (230 acres); the other in the Rio Grande Village wetland, burning approximately 8 hectares (19 acres).

Direct effects:

Black-capped vireo

Individual black-capped vireos may be affected by uncontrolled wildfire through direct mortality of nestlings and fledglings which cannot fly away. It is unlikely adult vireos would be affected due to their mobility. However, nestlings and fledglings, which cannot fly, may be affected by smoke inhalation.

Anecdotal evidence suggests that fire can benefit the black-capped vireo over the long term at BBNP. Most of the potential habitat at the park is at a post-successional ("climax") stage. Bringing vegetation to an earlier successional stage may result in a higher density of vireos breeding in the available habitat. However, this hypotheses needs to be further studied.

The area burned in the 1999 Casa Grande fire is described as "an upslope, headfire burn which virtually removed all canopy". This area probably contained vireo habitat prior to 1999. Despite the severity of the burn, six years later this area is showing signs of being suitable for habitation by vireos (Armstrong pers. comm. 2004). However, the rate of vegetation growth is dependent on climatic factors, such as precipitation patterns and temperature. During drought periods, vegetation recovery following a fire could be impeded. Armstrong (pers. comm. 2004) suggests it may take 7-12 years for habitat in this drier west Texas area to be suitable for vireos following a burn.

A net benefit to the vireo can result from the restoration of areas as small as 8 hectares (20 acres) if it is within 30 kilometers (19 miles) of occupied habitat patches (Wolfe 2004). As noted

before, not all potential habitat at BBNP is occupied, so restoration through the use of controlled burns or wildfire of unoccupied areas may not benefit this species in the park. The amount of unoccupied habitat is probably the result of the location of BBNP, which is at the western edge of the species breeding range. Nevertheless, vireo density in occupied habitat at the park probably closely resembles that at Rancho La Escondida in neighboring Coahuila, Mexico, where an estimated 3.29 singing males per hectare (approximately 1.28 singing males per acre) was recorded in 2003. This is approximately three times the commonly accepted density in central Texas (Farquhar et al. 2003). Habitat at BBNP probably more closely resembles that in Coahuila, resulting in a higher density of occupation at BBNP than what is typical in central Texas.

Chisos Mountain hedgehog cactus

Individual cacti may be directly affected by fire from buffelgrass burning in proximity. Currently, it is unknown how much of the areas occupied by Chisos Mountain hedgehog cactus are infested with buffelgrass. Only those areas that are infested with buffelgrass have enough fuel to carry a fire that may adversely affect this species.

Mexican long-nosed bat

Although Mexican long-nosed bats in Emory Cave could be directly affected by smoke, fire, or embers that occur from wildfires, no controlled burns (as described in the FMP) will occur during the roosting season of the bat. The threat from fire should be reduced by the proposed thinning of vegetation outside Emory Cave as part of the fuels reduction treatments.

Because it is nectarivorous, this species' guano is more like "bird droppings" (liquid-like) (Loren Ammerman, Angelo State University, pers. comm. 2005). This results in guano that does not accumulate in piles, but evaporates quickly leaving residue that is easily dispersed. Other bats, such as fringed myotis (*Myotis thysanodes*) and Townsend's big-eared bats (*Corynorhinus townsendii*), also use Emory Cave (England et al. 2003), and are insectivorous, which may result in more flammable guano. Embers or flames can ignite these piles of guano, which may smolder for years, discouraging or eliminating bats from roosting in the cave.

Emory Cave has two openings: one "main" entrance and one "skylight" which bats use to escape when disturbed. This results in a constant "breeze" through the cave. Mexican long-nosed bats roost in an upper level of the cave on a high ceiling (Service 1994), which may make it easier to escape through the "skylight" if disturbed by smoke from fires or burning embers. However, young bats may not be able to escape. It is unclear if these openings provide sufficient ventilation to prevent the bats from being affected by smoke inhalation.

Indirect effects:

Black-capped vireo

Black-capped vireos may be indirectly affected by inhaling smoke from a nearby fire, even if it does not directly encroach on their habitat. It is unlikely adult black-capped vireos will be affected by smoke inhalation from wildfire due to their high mobility.

The primary food source for black-capped vireos are insects associated with the deciduous trees in which the species nests. The vireo could be indirectly affected by loss of the prey base as trees are burned.

Mexican long-nosed bat

Fire may affect this species by reducing the amount of agaves used as food. There are approximately 20,775 hectares (51,337 acres) of primary and 28,839 hectares (71,263 acres) of secondary agave habitat available for the Mexican long-nosed bats to feed from in BBNP (Betty Alex pers. comm. 2005). It appears agaves are fire-adapted. They reproduce sexually and asexually, and they commonly resprout from rhizomes after a fire (Benson and Darrow 1981, Freeman 1973, Gentry 1972). The apical meristem (growing point) of agaves is usually protected from fire by leaves that cluster around it (McPherson 1995). Fire may open up areas of dense vegetation, leaving larger areas for agave seeds to land and favoring recruitment by reducing competition with other plants (Howell 1996).

A study on *Agave palmeri* in Arizona showed that agaves burned in a hot June fire had a faster stalk growth rate and produced a higher volume and concentration of nectar than in a control plot. This suggests that fire occurring within the reproductive period may release nutrients which agave quickly take up, reflecting a more robust growth stalk and more flowers, which may benefit the MLNB. However, the same study also found higher mortality of young plants which were not protected from fire by leaves. Visitation by animals was also higher in burned plots, resulting in pressure on seedlings from feeding and trampling (Howell 1996).

The primary bat foraging areas for Mexican long-nosed bats are in the Chisos Basin in FMU #2. The areas of highest concern are those closest to Emory Cave, as it appears visitation rates to agaves are directly correlated to distance from the roost site; that is, bats more frequently visit agaves closest to the roost site. It is thought that the bats visit these closer areas of agaves first to gain energy before beginning their nightly commute to more remote areas (Ober and Steidl 2004). Therefore, hot, destructive wildfire in those foraging areas closest to Emory Cave could cause the most negative effects to the species.

Cumulative Effects

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Almost no cumulative effects are expected to occur in the portion of the action area within the park boundaries. The remaining 1.6-kilometer (1-mile) buffer is not expected to experience significant development due to its remote location from major metropolitan areas. The only towns within or near this buffer are Terlingua and Lajitas, both located near the western boundary of the park. Most, if not all, of the buffer area is privately owned. Big Bend Ranch State Park and Big Bend State Natural Area occur in proximity, but not within this buffer.

Brewster County is sparsely populated with 9,247 residents in 2003, a 4.3 percent increase from the 2000 population (U.S. Census Bureau 2005). There were about 1.4 persons per square mile in Brewster County in 2000, compared to the state average of 79.6 persons per square mile.

CONCLUSION

The conclusion of this biological opinion is based on full implementation of the project as described in the BA, EA, and the Summary of the Proposed Action in this document. This includes the conservation measures that were incorporated into the project design.

The Service has determined that the project, as proposed, is not likely to jeopardize the continued existence of the black-capped vireo, Chisos Mountain hedgehog cactus, or the Mexican long-nosed bat. No critical habitat has been designated for any of the species, therefore, none will be affected.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act

provided that such taking is in compliance with the terms and conditions of this incidental take statement.

As discussed above, sections 7(b)(4) and 7(o)(2) of the Act generally do not apply to listed plant species. However, limited protection of listed plants from take is provided to the extent that the Act and the implementing regulations prohibit the removal and reduction to possession of federally listed threatened or endangered plants or the malicious damage of endangered plants on areas under federal jurisdiction, or the destruction of endangered plants on non-federal areas in violation of state law or regulation or in the course of any violation of a state criminal trespass law.

Amount or Extent of Take Anticipated

Black-capped vireo

Incidental take that may result from prescribed burning is expected to be in the form of harm through habitat alteration or destruction, which may cause vireos to avoid breeding or feeding in recently burned areas. Direct take may result from the non-suppression of wildfire if it encroaches upon occupied habitat during the March 1-August 15 breeding season.

Based on Figures 2 and 7 of the BA, it appears most areas of occupied habitat are not proposed for prescribed burning. Based on our estimate of 297 hectares (735 acres) of total habitat, an estimated density of 1 territory per 0.8 hectares (2 acres), and the staggered schedule of prescribed fire over 8 years, the Service anticipates up to 2 black-capped vireo territories could be taken from loss of habitat per year in BBNP, for a total of 14 (beginning in 2005 through 2012), as a result of prescribed fire.

No take from wildfire should occur, assuming suppression occurs before wind and moisture limits are exceeded and fuel reduction efforts are successful at averting a catastrophic wildfire. In the event of a wildfire under conditions that exceed wind and moisture criteria (see Table II-7 of the EA), the Service should be notified immediately to determine if emergency consultation is necessary.

Mexican long-nosed bat

The Service anticipates incidental take of Mexican long-nosed bats will be difficult to detect due to the following reasons: the species roosts in habitat (i.e., Emory Cave) that makes detection difficult; the amount and extent and feeding (agave) habitat is extensive; and the species can travel far distances from Emory Cave to feed. However, the following level of take of this species can be anticipated by loss of an unquantifiable amount of feeding habitat and effects to roosting individuals in Emory Cave from naturally-ignited and prescribed fire. The Service anticipates take in the form of harm, harassment, or direct take of up to 5 Mexican long-nosed bats per year from the proposed action. Because the population of this species varies widely year

to year at Emory Cave, we are unable to determine a percentage of the overall population this amount of take entails.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize incidental take of black-capped vireos and Mexican long-nosed bats:

1. Harm and harassment of black-capped vireos or Mexican long-nosed bats during activities associated with burn implementation and wildfire suppression will be minimized; and,
2. Effects of temporary losses and degradation of breeding and foraging habitat for black-capped vireos and Mexican long-nosed bats will be minimized.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, BBNP must comply with the following terms and conditions, which implement the RPMs described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

The following terms and conditions implement both RPMs:

- All conservation measures outlined in the BA will be strictly adhered to. If any deviation from these measures occurs, the Service must be consulted.
- BBNP fire and science and resource management staff must closely coordinate on wind and moisture criteria for wildfire suppression and prescribed burns to reduce unintended impacts to vireo and bat habitat.
- Avoid all prescribed burning within 1.6 kilometers (1 mile) of black-capped vireo habitat during vireo breeding season (March 15 – August 31) to avoid direct take. Do not burn more than half of the habitat outside of the breeding season in any of the currently or previously occupied areas (Juniper Canyon, Pine Canyon, Green Gulch, Blue Creek Ranch, Casa Grande, Panther Canyon, Laguna Meadows, and the Chisos Basin).

The RPMs, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the RPMs provided. NPS must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the RPMs.

Reporting requirements:

- The Service will be notified immediately of any wildfires or prescribed fires that escape or otherwise exceed wind and moisture criteria within known or potential black-capped vireo or Mexican long-nosed bat breeding, feeding, or foraging habitat.
- Written annual reports of the year's activities will be submitted by October 1 of each year (until the next revision of the FMP) to our office and to the U.S. Fish and Wildlife Service, P.O. Box 1306, Room 4102, Albuquerque, New Mexico 87103. These reports must include: schedule of prescribed burns, research results from prescribed and wildfire, and survey results (including maps of surveyed areas) for black-capped vireos and Mexican long-nosed bats.

Conservation Recommendations

Section 7(a)(1) of the Act directs federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

- Implement further study on effects to black-capped vireos from cowbirds. Cowbirds have been seen in areas of occupied habitat (Cornelius 2004), and parasitism on vireos has been documented in BBNP (Maresh and Hernandez 1999, Peck and Barlow 2000, Wauer 1973) and in neighboring Coahuila (Farquhar 2005). Cowbird control has been shown to reduce parasitism rates at Fort Hood (Summers and Norman 2003).
- BBNP should consider using call boxes to attract black-capped vireos to areas of potential, but unoccupied habitat, following prescribed fire and when the habitat is determined to be suitable for occupation by this species. Call boxes should not be placed in or adjacent to habitat that is threatened by severe stand-replacing wildfire, i.e. areas with high fuel load. This method has proven successful at Fort Hood at attracting vireos to potential habitat.
- Continue the efforts to eradicate buffelgrass from those areas that support Chisos Mountain hedgehog cactus.
- Work with Bat Conservation International for the benefit of the Mexican long-nosed bat.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of implementation of any conservation recommendations.

Reinitiation Notice

As provided in 50 CFR Sec. 402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new

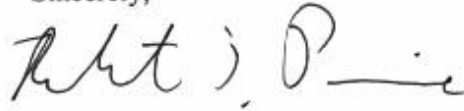
Mr. John H. King

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information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this consultation; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this biological opinion; or, (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

This concludes formal consultation on the proposed Big Bend National Park Fire Management Plan. If you have any questions regarding this draft Biological Opinion, please contact Jana Milliken at 512-490-0057, extension 243, or jana_milliken@fws.gov.

Sincerely,

A handwritten signature in black ink, appearing to read "Robert T. Pine". The signature is written in a cursive style with a large initial "R" and a long horizontal stroke at the end.

Robert T. Pine
Supervisor

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Figure 1

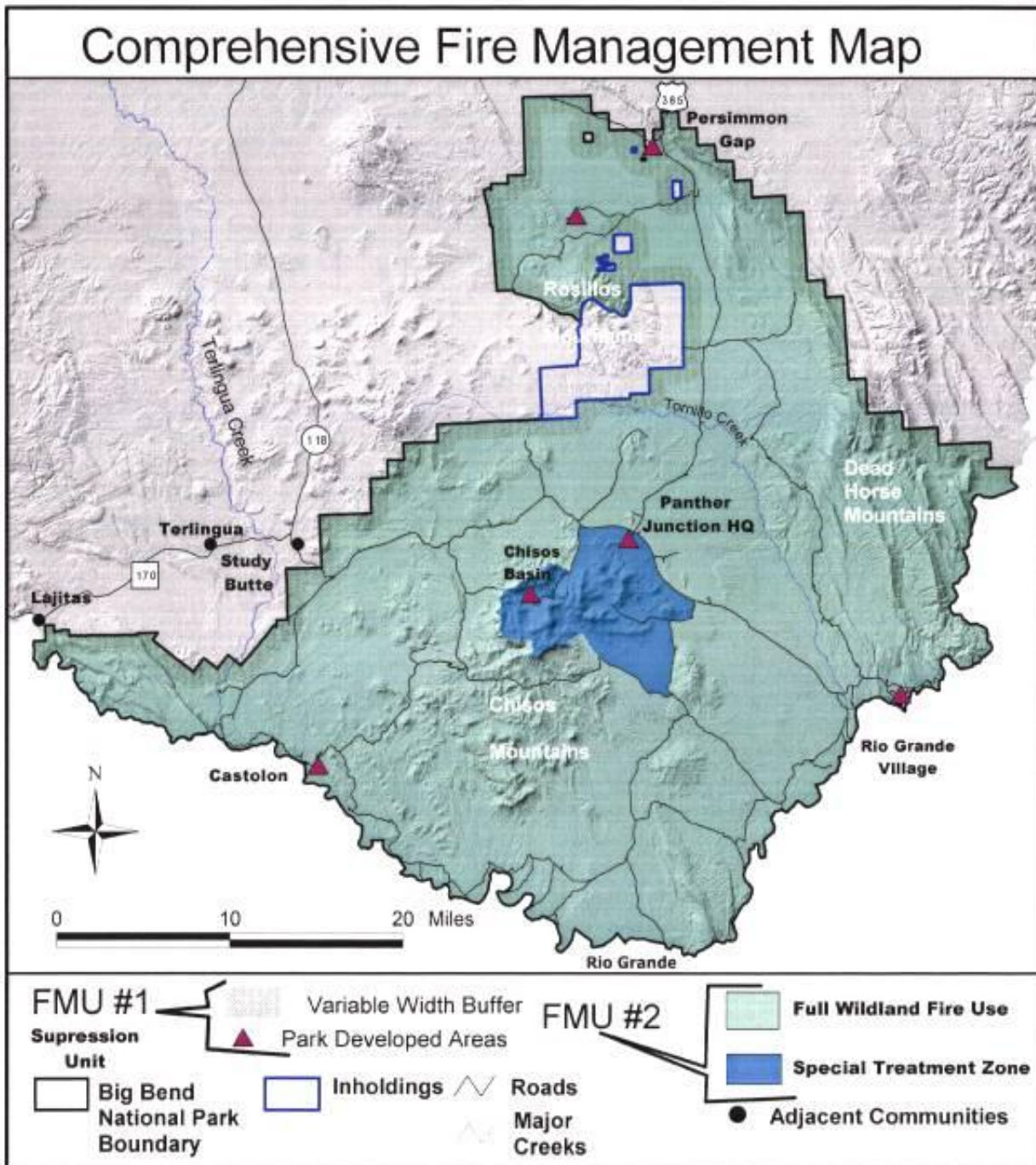


Figure 2

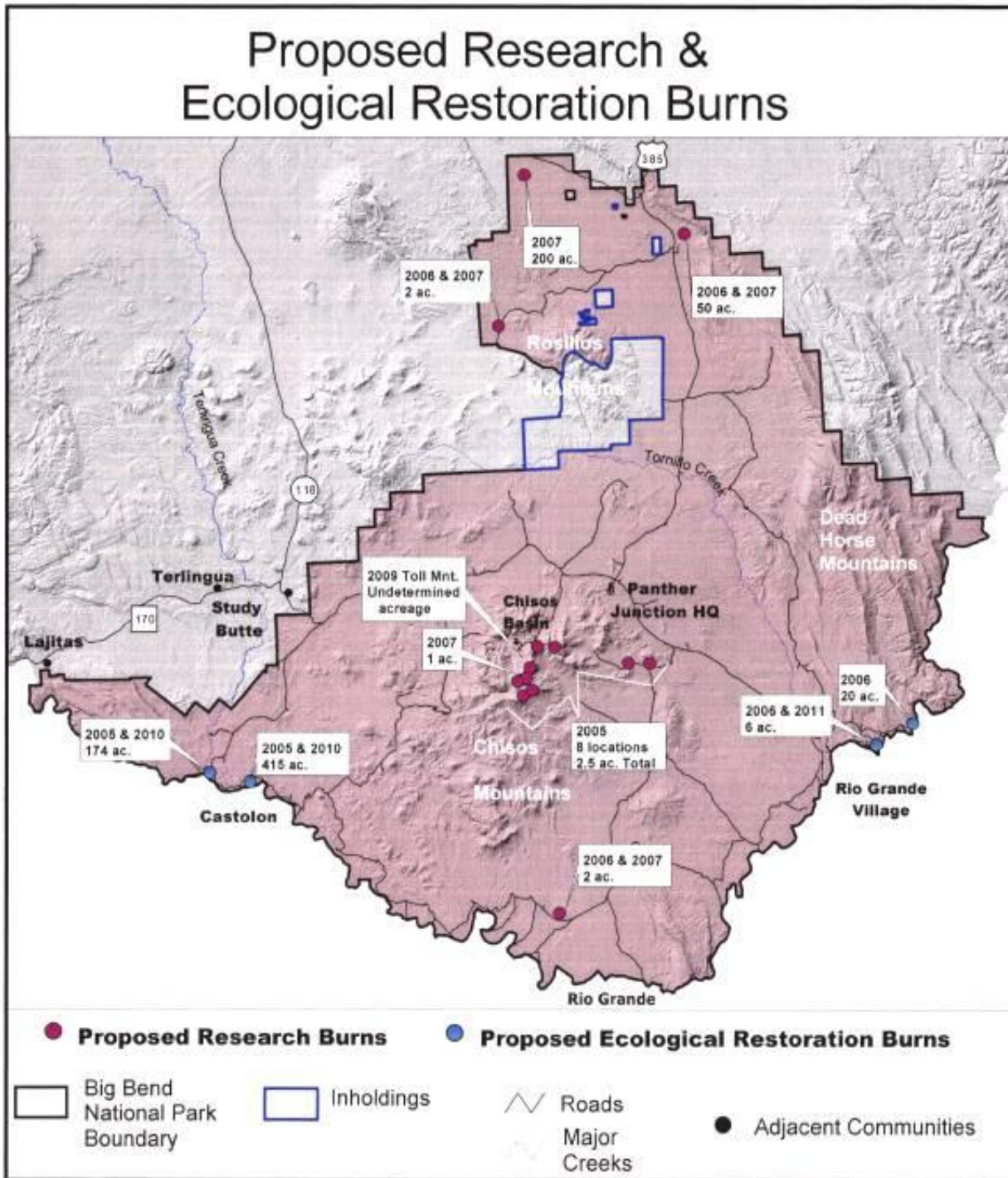


Figure 3

