National Park Service
U.S. Department of the Interior

Grand Canyon National Park
Arizona

# Grand Canyon National Park
# Wildland Fire Management Plan

Volume 2 of 2 July 2005

# Appendix A – References Cited

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# Appendix B – Glossary of Terms and Acronyms

**Appropriate Management Response (AMR).** Specific actions taken in response to a wildland fire to implement protection and fire use objectives.

**Burned Area Emergency Rehabilitation (BAER).** The full range of post- fire activities to rehabilitate and restore fire damaged lands, including protection of public health and safety.

**Conditional Wildland Fire Use.** Refers to a temporary Fire Management Unit (see definition below), where once fuels management objectives are accomplished, the Unit will be added to the Wildland Fire Use (see definition) Unit.

**Cooperators.** Federal, state, and local agencies and Indian tribes that participate in planning and conducting fire management projects and activities.

**Ecosystem Sustainability.** The capacity to maintain ecosystem health, productivity, diversity, and overall integrity, in the long run, in the context of human activity and use.

**Fire Management Plan (FMP).** A strategic plan that defines a program to manage wildland and prescribed fires and documents the fire management program in the approved land use plan. The plan is supplemented by operational plans such as preparedness plans, preplanned dispatch, prescribed fire plans, and prevention plans.

**Fire Management Unit (FMU).** Any land management area definable by objectives, topographic features, access, values- to- be- protected, political boundaries, fuel types, or major fire regimes, etc., that set it apart from management characteristics of an adjacent unit. FMU(s) are delineated in fire management plans. These units may have dominant management objectives and pre- selected strategies to accomplish these objectives.

**Fire Use Manager (FUMA).** Individual qualified and responsible for the management of wildland fires used for resource benefits (see WFURB).

**Holding Actions.** Planned actions required to achieve wildland and prescribed fire management objectives. Specific holding actions are developed to preclude fire from exceeding the MMA (or Allowable Area).

**Initial Response.** A management action on an initiating fire consistent with firefighter and public safety and values to be protected.

**Incident Commander (IC).** Individual responsible for the management of all incident operations at the incident.

**Incident Management Team (IMT).** The incident commander and appropriate general and command staff personnel assigned to an incident.

**Interdisciplinary Team (IDT).** Group of specialists involved in identification of goals and objectives, and potential issues and mitigation measures associated with a proposed project or management action.

**Management Action Points.** See Trigger Points.

**Maximum Manageable Area (MMA).** The firm limits of management capability to accommodate the social, political, and resource impacts of a wildland fire. Once established as part of an approved plan, the general impact area is fixed and not subject to change. If they are developed after the ignition, their definition will occur during the Wildland Fire Implementation Plan Stage III process. In the event a fire occurs in a preplanned MMA and the local unit determines that this MMA is not the best suited alternative for present conditions, a new MMA can be developed as part of the Stage III process. Once this occurs, the Stage III MMA becomes the firm limits of the fire and is fixed.

**Minimum Impact Management Tactics (MIMT).** Also termed Minimum Impact Suppression Tactics (MIST), the application of strategy and tactics that effectively meet management objectives with the least environmental, cultural, and social impacts.

**Mitigation Actions.** Those on the ground activities that will serve to increase the defensibility of the MMA; check, direct, or delay the spread of fire; and minimize threats to life, property, or resources. These actions will be used to construct firelines, reduce excessive fuel concentrations, reduce vertical fuel continuity, create fuel breaks or barriers around critical or sensitive sites or resources, create "blacklines" through controlled burnouts, and to limit fire spread and behavior.

**Preparedness.** Activities that lead to a safe, efficient, and cost- effective fire management program in support of land and resource management objectives through appropriate planning and coordination.

**Prescribed Fire.** Any fire ignited by management actions to meet specific objectives. A written, approved prescribed fire plan must exist, and NEPA requirements must be met, prior to ignition.

**Prescription.** Measurable criteria that define conditions under which a prescribed fire may be ignited, guide selection of appropriate management responses, and indicate other required actions. Prescription criteria may include safety, economic, public health, environmental, geographic, administrative, social, or legal considerations.

**Standard Operating Procedures (SOP).** Procedures that are common to a work unit.

**Trigger Points.** Either geographic points on the ground or specific points in time where an escalation or alteration of management actions is warranted. These points are defined and the management actions to be taken are clearly described in an approved Wildland Fire Implementation Plan (WFIP) or Prescribed Fire Plan. Timely implementation of the actions when the fire reaches the action point is generally critical to successful accomplishment of the objectives.

**Values to be Protected.** Include property, structures, physical improvements, natural and cultural resources, community infrastructure, and economic, environmental, and social values.

**Wildland Fire.** Any non- structure fire, other than prescribed fire, that occurs in the wildland. This term encompasses fires previously called both wildfires and prescribed natural fires.

**Wildland Fire Implementation Plan (WFIP).** A progressively developed assessment and operational management plan that documents the analysis and selection of strategies and describes the appropriate management response for a wildland fire being managed for resource benefits. A full WFIP consists of three stages. Different levels of completion may occur for differing management strategies (i.e., fires managed for resource benefits will have two- three stages of the WFIP completed while some fires that receive a suppression response may only have a portion of Stage I completed).

**Wildland Fire Situation Analysis (WFSA).** A decision- making process that evaluates alternative management strategies against selected safety, environmental, social, economic, political, and resource management objectives.

**Wildland Fire Suppression.** 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 fire suppression activities provide for firefighter and public safety as the highest consideration, but minimize the loss of resource values, economic expenditures, and/or the use of critical firefighting resources.

**Wildland Fire Use for Resource Benefit (WFURB, WFRB).** The management of naturally ignited wildland fires to accomplish specific pre- stated resource management objectives in predefined geographic areas outlined in FMP's. Operational management is described in the WFIP. Wildland fire use is not to be confused with "fire use" which is a broader term encompassing more than just wildland fires.

**Wildland Urban Interface (WUI).** Defined as the line, area, or ozone where structures and other human development meet or intermix with undeveloped wildland or vegetative fuels.

# Appendix C – Species Lists
# Species that are of special management concern

## Kingdom Animalia

| Scientific name | Common name | Status | Taxonomic group |
|---|---|---|---|
| *Gila cypha* | humpback chub | Federal Endangered | fish |
| *Rana pipiens* | Northern leopard frog | State Species of Concern | amphibian |
| *Rana onca* | relict leopard frog | State Species of Concern (Fed Candidate) | amphibian |
| *Gopherus agassizii* | desert tortoise | Federal Threatened | reptile |
| *Empidonax trailli extimus* | Southwestern willow flycatcher | Federal Endangered | bird |
| *Haliaeetus leucocephalus* | bald eagle | Federal Threatened | bird |
| *Coccyzus americanus occidentalis* | yellow- billed cuckoo | State Species of Concern (Fed Candidate) | bird |
| *Gymnogyps californianus* | California condor | Federal Threatened | bird |
| *Strix occidentalis lucida* | Mexican spotted owl | Federal Threatened | bird |
| *Rallus longirostis yumanensis* | Yuma clapper rail | Federal Endangered | bird |
| *Accipiter gentalis* | Northern goshawk | State Species of Concern (FS sensitive) | bird |
| *Falco peregrinus anatum* | peregrine falcon | sensitive (delisted <5yrs ago) | bird |
| *Buteo regalis* | ferruginous hawk | State Species of Concern | bird |
| *Sciurius aberti kaibabensis* | Kaibab squirrel | National Natural Landmark | mammal |
| *Ovis canadensis* | desert bighorn sheep | Navajo Nation Listed | mammal |
| *Perognathus amplus ammodytes* | Wupatki pocket mouse | sensitive | mammal |
| *Dipodomys microps leucotis* | Marble Canyon kangaroo rat | State Species of Concern | mammal |
| *Macrotus californicus* | California leaf- nosed bat | State Species of Concern | mammal |
| *Choenycteris mexicana* | Mexican long-tongued bat | State Species of Concern | mammal |
| *Euderma maculatum* | spotted bat | State Species of Concern (FS sensitive) | mammal |
| *Microtus mexicanus hualapaiensis* | Hualapai Mexican vole | Federal Endangered | mammal |
| *Microtus mexicanus navajo* | Navajo Mexican vole | State Species of Concern | mammal |
| | | | |
| *Archeolarca cavicola* | Grand Canyon cave pseudoscorpion | sensitive (rare) | invertebrate |
| *Oxyloma haydeni kanabensis* | Kanab ambersnail | Federal Endangered | invertebrate |

# Kingdom Plantae

| *Scientific name* | **Common name** | **Status** | **Organism Type** |
|---|---|---|---|
| *Pediocactus peeblesianus* | Peebles Navajo cactus | Federal candidate and state endangered | plant |
| *Astragalus cremnophylax chremnophylax* | sentry milk vetch | Federal - endangered | plant |
| *Penstemon distans* | Mt. Trumball beardtongue | sensitive | plant |
| *Arctomecon californica* | golden- bear poppy | sensitive | plant |
| *Rosa stellata* | Grand Canyon rose | sensitive | plant |
| *Primula specuicola* | cave primrose | sensitive (imperiled in the state) | plant |
| *Clematis hirsutissima arizonica* | Arizona leatherflower | sensitive (rare) | plant |
| *Argemone arizonica* | Arizona prickle-poppy | sensitive (rare) | plant |
| *Chrysothamnus molestus* | Arizona rabbit- brush | sensitive (rare) | plant |
| *Camissonia confertiflora* | bunch flower evening primrose | sensitive (rare) | plant |
| *Astragalus cremnophylax myriorrhaphis* | cliff milkvetch | sensitive (rare) | plant |
| *Lesquerella kaibabensis* | Kaibab bladderpod | sensitive (rare) | plant |
| *Castilleja kaibabensis* | Kaibab indian paintbrush | sensitive (rare) | plant |
| *Pediocactus paradinei* | Kaibab pincushon cactus | sensitive (rare) | plant |
| *Talinum validulum* | Tusayan flame flower | sensitive (salvage restricted) | plant |

# Appendix D

# Compliance Documents

## A. Cultural Resources

Programmatic Agreement

## B. Natural Resources

Programmatic Wildland Fire Use BE
Programmatic Prescribed Fire BE

NPS Office of Policy: NPS- 28, Cultural Resource Management
NPS- 28: CULTURAL RESOURCE MANAGEMENT GUIDELINE
APPENDIX P: 1995 Servicewide Programmatic Agreement

PROGRAMMATIC AGREEMENT AMONG THE NATIONAL PARK SERVICE
(U.S. DEPARTMENT OF THE INTERIOR),
THE ADVISORY COUNCIL ON HISTORIC PRESERVATION,
AND
THE NATIONAL CONFERENCE OF STATE HISTORIC PRESERVATION OFFICERS

WHEREAS, the National Park Service (NPS) plans for, operates, manages, and administers the National Park System, and is responsible for preserving, maintaining, and interpreting the cultural resources of the System unimpaired for the enjoyment of future generations; and

WHEREAS, the operation, management, and administration of the System entail undertakings that may affect historic properties (as defined in 36 CFR Part 800), which are therefore subject to review under Sections 106, 110(f) and 111(a) of the National Historic Preservation Act as amended (NHPA; 16 USC 470 et seq.) and the regulations of the Advisory Council on Historic Preservation (Council) (36 CFR Part 800); and

WHEREAS, the NPS has established management policies, guidelines, standards, and technical information designed for the treatment of cultural resources consistent with the spirit and intent of the NHPA; and

WHEREAS, the NPS has a qualified staff of cultural resources specialists in parks, System Support Offices, and archeological and preservation centers to carry out programs for cultural resources; and

WHEREAS, the NPS has consulted with the National Conference of State Historic Preservation Officers (Conference) and the Council regarding ways to ensure that NPS operation, management, and administration of the System provide for management of the System's cultural resources in accordance with the intent of NPS policies and with Sections 106, 110, and 111 of the NHPA; and

WHEREAS, the National Park Service, the Conference, and the Council executed a Nationwide Programmatic Agreement in 1990 that is superseded with the execution of this Programmatic Agreement; and

WHEREAS, the NPS has re- structured in order to place more resources and delegations of authorities with park managers;

NOW, THEREFORE, the NPS, Conference, and Council mutually agree that the NPS will carry out its Section 106 responsibilities with respect to management of the System in accordance with the following stipulations:

STIPULATIONS

I. POLICY

The NPS will continue to preserve and foster appreciation of the cultural resources in its custody through appropriate programs of protection, research, treatment, and interpretation. These efforts are and will remain in keeping with the NHPA, the National Environmental Policy Act (NEPA), the American Indian Religious Freedom Act, the Archaeological Resources Protection Act, the Archeological and Historic Preservation Act of 1974, the Native American Graves Protection and Repatriation Act, the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation, NPS Management Policies, and the Guidelines for Federal Agency Responsibilities Under Section 110 of the National Historic Preservation Act. It remains the NPS goal to implement these programs in consultation with other Federal agencies, State Historic Preservation Officers (SHPOs), Indian tribes, local governments, and the public. Other guidelines, standards, and regulations relevant to this Agreement and its purposes include:

- NPS- 28, Cultural Resource Management Guideline
- NPS- 2, Planning Process Guideline
- NPS- 6, Interpretation and Visitor Services Guideline
- NPS- 12, NEPA Compliance Guideline
- NPS- 38, Historic Property Leasing Guideline
- 36 CFR Part 18, Leases and Exchanges of Historic Property

II. IDENTIFYING CULTURAL RESOURCES

The NPS will coordinate with SHPOs activities for research related to resource management needs and identification, evaluation, and registration of park historic properties. NPS fulfills these responsibilities under Section 110 of the NHPA and 36 CFR Part 800.4, with regard to properties potentially significant at national, State, or local levels and mindful of State preservation planning and inventory programs.

III. DELEGATION OF AUTHORITY

A. Park superintendents are the responsible agency officials as defined in 36 CFR Part 800.1(c)(1)(i) for purposes of Section 106 compliance. They will assume this responsibility in accordance with Stipulation VIII below.

B. Superintendents will be held accountable for their performance in Section 106 compliance through NPS procedures for performance and program evaluation.

C. To meet this responsibility, each park will have the following:

1. a commitment to training park staff, including an invitation to the appropriate SHPO and the Council to participate in that training, so that park staff are generally familiar with Section 106 processes; and

2. at least one staff person qualified to act as the park's 106 coordinator, whose 106 responsibilities are specified in his or her position description and performance standards; and

3. a formally designated set of CRM advisers whose qualifications are consistent with OPM standards, the intent of 36 CFR Part 61, Appendix A, and the intent of Section 112(a)(1)(B) of the National Historic Preservation Act. In- park staff, System Support Offices, other parks, NPS cultural preservation and archeological centers, Denver Service Center, other government

agencies, and specialists and scholars outside NPS are all possible sources for needed expertise. Specialists who are not federal employees must meet the standards in 36 CFR Part 61, Appendix A.

D. SHPOs and the Advisory Council may at any time raise with the appropriate Field [Regional] Director any programmatic or project matters where they wish the Field Director to review a park superintendent's decision.

IV. PROJECT REVIEW–NATIONWIDE PROGRAMMATIC EXCLUSIONS

A. Undertakings listed in IV.B will be reviewed for Section 106 purposes within the NPS, without further review by the Council or SHPOs, provided:

1. that these undertakings are based upon information adequate to dentify and evaluate affected cultural resources [except for IV.B.(5)];
2. that the NPS finds that their effects on cultural resources in or eligible for the National Register will not be adverse based on criteria in 36 CFR Part 800.9; and
3. that decisions regarding these undertakings are made and carried out in conformity with applicable policies, guidelines, and standards as identified in Stipulation I, and are documented by NPS using the form for "Assessment of Actions Having an Effect on Cultural Resources" or another appropriate format. (See Stipulation VII below.)

B. The following undertakings may be reviewed under the terms of IV.A:

1. preservation maintenance (housekeeping, routine and cyclic maintenance, and stabilization) as defined in NPS- 28;
2. routine grounds maintenance, such as grass cutting and tree trimming;
3. installation of environmental monitoring units, such as those for water and air quality;
4. archeological monitoring and testing and investigations of historic structures and cultural landscapes involving ground disturbing activities or intrusion into historic fabric for research or inventory purposes (see also Stipulations II and IX.C);
5. acquisition of lands for park purposes, including additions to existing parks;
6. rehabilitation and widening of existing trails, walks, paths, and sidewalks within previously disturbed areas;*
7. repaving of existing roads or existing parking areas within previously disturbed areas;*
8. placement, maintenance, or replacement of utility lines, transmission lines, and fences within previously disturbed areas;*
9. rehabilitation work limited to actions for retaining and preserving, protecting and maintaining, and repairing and replacing in kind materials and features, consistent with the Secretary of the Interior's Standards for Rehabilitation and the accompanying guidelines;
10. health and safety activities such as radon mitigation, and removal of asbestos, lead paint, and buried oil tanks;
11. installation of fire detection and suppression systems, and security alarm systems, and upgrading of HVAC systems;
12. erection of signs, wayside exhibits, and memorial plaques;
13. leasing of historic properties consistent with NPS- 38, if proposed treatments are limited to those consistent with IV.B(1) and (9) and other activities excluded under IV.A and B.

C. Park superintendents and SHPOs may develop additions to Stipulation IV.B that identify other types of undertakings that they mutually agree will be excluded from further review. Proposals for such additions will be provided for review to the Executive Director of the Council, the NPS Director, and the Executive Director of the Conference. Upon their acceptance, the Council, the Conference, and NPS will maintain records on those additions as amendments to this Agreement, and provide for dissemination to other appropriate SHPOs and NPS offices.

D. In the event that a SHPO questions whether a project should be considered a programmatic exclusion under Stipulation IV.A and B, the superintendent and SHPO will make every effort to resolve the issue informally. If those efforts fail, the question will be referred to the Field [Regional] Director. If the matter is still not resolved, it will be referred to the Advisory Council in accordance with Stipulation XI.A.

## V. PROJECT AND PROGRAM REVIEW–OTHER UNDERTAKINGS

A. All undertakings (as defined in 36 CFR Part 800), with the exception of those that meet provisions in Stipulation IV, will be reviewed in accord with 36 CFR Part 800.
B. Superintendents are encouraged to evaluate their park's programs and discuss with SHPOs ways to develop programmatic agreements for park undertakings that would otherwise require numerous individual requests for comments.
C. Memoranda of Agreement and Programmatic Agreements specific to a project, plan, or park may be negotiated between park superintendents and SHPOs, pursuant to 36 CFR Part 800.5(e) or 800.13, and may be independent of or supplement this Agreement.

## VI. RELATIONSHIP OF PROJECT REVIEW TO PLANS

A. To the extent that the requirements of Section 106 and NEPA overlap for a given plan or project, superintendents are encouraged to coordinate these two processes, including the preparation of documentation and public involvement processes, in accordance with the guidance in 36 CFR Part 800 or otherwise provided by the Advisory Council.
B. In conformity with 36 CFR Part 800.3(c), park superintendents will ensure that the Section 106 process is initiated early in the planning stages of any given undertaking, when the widest feasible range of alternatives is open for consideration.
C. General Management Plans (GMPs) establish a conceptual framework for subsequent undertakings, and can thus play an important role in this process. GMPs may constitute the basis for consultation under 36 CFR Part 800.4- 6 on individual undertakings, if sufficient information exists for resource identification, determination of National Register eligibility, and assessment of the effect of a proposed undertaking on the property in question. In the absence of such information, Section 106 consultation will normally be initiated or completed at subsequent stages in the planning process [such as Development Concept Plans (DCPs) or other subsequent implementing plans, as defined in NPS- 2].
D. The park superintendent will notify the appropriate SHPO and the Council when a GMP or DCP is scheduled for preparation, amendment, revision, or updating. The superintendent will request comments regarding preservation concerns relevant to the plan, such as management objectives, identification and evaluation of historic properties, and the potential effects of individual undertakings and alternatives on historic properties.
E. During the planning process, the park superintendent, in consultation with the SHPO, will make a determination about which undertakings are programmatic exclusions under IV.A and B, and for all other undertakings, whether there is sufficient information about resources and potential effects on those resources to seek review and comment under 36 CFR Part 800.4- 6 during the plan review process. In cases where consultation is completed on specific undertakings, documentation of this consultation will be included in the GMP or DCP.
F. The approved plan will list all undertakings in the plan that are subject to further consultation, and the stage of planning at which consultation is most likely to be completed.
G. NPS GMPs will include a statement about the status of the park's cultural resources inventory and will indicate needs for additional cultural resource information, plans, or studies required before undertakings can be carried out.

## VII. NPS PROCESS FOR DOCUMENTING ACTIONS HAVING AN EFFECT ON CULTURAL RESOURCES

All System- related undertakings that may have an effect on cultural resources will be appropriately documented and carried out in accordance with applicable policies, guidelines, and standards, as identified in Stipulation I. Formats for documentation include those outlined in published Advisory Council guidance (see "Preparing Agreement Documents," for example), the NPS "Assessment of Actions Having an Effect on Cultural Resources" form, programmatic agreements and, where appropriate, NEPA documentation that addresses cultural resources issues with information consistent with requirements of 36 CFR Part 800. Cultural resources specialists will review all such actions prior to their implementation, and parks will maintain documentation of this review. Documentation of NPS reviews not already provided to SHPOs and the Council will be available for review by the Council and the appropriate SHPO upon request. Individual SHPOs who wish to review this documentation are responsible for specifying scheduling, frequency, and types of undertakings of concern to them.

## VIII. PUTTING THIS AGREEMENT INTO EFFECT

The delegation of Section 106 responsibility to park superintendents will take place as of October 1, 1995. As a condition of this delegation, each park will identify A. the specialists, on or off park staff, who will provide the park with advice and technical services for cultural resource issues related to Section 106 compliance. These specialists must be qualified in their areas of expertise and have a specified term of commitment to advise the park; and B. a contact person to coordinate the park's Section 106 compliance processes.

Parks supplement on- staff expertise through advice and technical services from CRM specialists in SSOs, the Denver Service Center, preservation centers, and other specified CRM specialists inside and outside the NPS, for advice and technical services involved in 106 documentation and consultation. The superintendent will be the responsible agency official for 106 purposes, who ensures the implementation of this agreement and 36 CFR Part 800 procedures, and who signs correspondence to SHPOs and the Advisory Council and documentation of programmatic exclusions.

## IX. COOPERATION AND COMMUNICATIONS

A. Within six months of the date of the signature of this PA by all parties, and every two years thereafter, each park superintendent will invite the appropriate SHPO(s) to meet to discuss the compliance process and any actions necessary to improve communications between the park and SHPO.
B. SHPOs, the Conference, and the Council will be informed and consulted about revisions to NPS standards and guidelines listed in Stipulation I.
C. SHPOs, parks and NPS System Support Offices will share information about inventories of historic properties, preservation planning processes, and historic contexts developed by each, as well as other reports and research results related to cultural resources.
D. SHPOs will treat the appropriate park superintendent as an interested party for purposes of State environmental and preservation laws as they may relate to park undertakings and cultural resources.

E. The Council and SHPOs will treat the appropriate park superintendent as an interested party under 36 CFR Part 800 for purposes of undertakings by other Federal agencies and Indian tribes that may affect NPS areas, including undertakings in areas in and around parks.
F. As required in NPS- 2, NPS- 12, the Section 110 Guidelines, and 36 CFR Part 800, NPS will provide opportunities for Indian tribes and other interested persons to participate in the processes outlined in this Agreement.

## X. RELATIONSHIP TO OTHER EXISTING AGREEMENTS

A. This Programmatic Agreement will become effective on October 1, 1995, and shall supersede the following existing Programmatic Agreements:

1. the Memorandum of Understanding executed in June 1976, regarding NPS planning documents;
2. the Programmatic Memorandum of Agreement executed on December 19, 1979, and its amendments dated September 1981 and December 1985 regarding planning documents, energy management, and preservation maintenance; and
3. the Programmatic Memorandum of Agreement executed on December 19, 1982, regarding leasing of historic properties.
4. the nationwide Programmatic Agreement of 1990.

B. Signature and implementation of this Agreement does not invalidate park- , Region- or project- specific Memoranda of Agreement or programmatic agreements negotiated for Section 106 purposes prior to the effective date of this Agreement.

## XI. DISPUTE RESOLUTION

A. Should a SHPO or the Council object to a park superintendent's decisions or actions pursuant to any portion of this Agreement, the superintendent will consult the objecting party to resolve the objection. If the park superintendent or the objecting party determines that the objection cannot be resolved, the superintendent will forward all documentation relevant to the dispute to the Field [Regional] Director for further consultation. If the objection still cannot be resolved, the Field Director will forward to the Council relevant documentation not previously furnished to the Council. Within 30 days after receipt of all pertinent documentation, the Council will either:

1. provide the Field Director with recommendations, which the Field Director will take into account in reaching a final decision regarding the dispute; or
2. notify the Field Director that it will comment pursuant to 36 CFR Part 800.6(b), and proceed to comment. Any Council comment provided in response to such a request will be taken into account by the Field Director with reference to the subject of the dispute.**

Any recommendation or comment provided by the Council will be understood to pertain only to the subject of the dispute. The NPS responsibility to carry out all actions under this Agreement that are not the subjects of the dispute will remain unchanged.
B. When requested by any person, the Council will consider NPS findings under this Agreement pursuant to the provisions of 36 CFR Part 800.6(e) on public requests to the Council.

## XII. MONITORING, TERMINATION, AND EXPIRATION

A. The National Park Service will convene a meeting of the parties to this Agreement on or about November 15, 1996, to review implementation of the terms of this Agreement and determine whether revisions or amendments are needed. If revisions or amendments are needed, the parties will consult in accordance with 36 CFR Part 800.13.
B. Any party to this Agreement may terminate it by providing ninety (90) days notice to the other parties, provided that the parties will consult during the period prior to termination to seek

agreement on amendments or other actions that would avoid termination. In the event of termination, the NPS will comply with 36 CFR Part 800 with regard to individual undertakings otherwise covered by this Agreement.

ADVISORY COUNCIL ON HISTORIC PRESERVATION
By: s/Cathryn B. Slater DATE: July 17, 1995
Chairman

NATIONAL PARK SERVICE
By: s/Roger G. Kennedy DATE: July 17, 1995
Director

NATIONAL CONFERENCE OF STATE HISTORIC PRESERVATION OFFICERS
By: s/W. Ray Luce DATE: July 17, 1995
President

Below are two explanatory notes that are not part of the PA text:
* IV.B(6),(7),(8)–The historic qualities of walks, trails, paths, and their surroundings should be carefully evaluated in assessing the potential for adverse effects. Not only potential archeological resources, but also the other kinds of values that might be affected must be considered. Is a particular path's surface finish, for example, a character- defining element in a cultural landscape? Will enlarging a parking lot have a visual impact on a National Register- eligible structure, site, or landscape? Would the new fence alter visual or design qualities of a historic landscape? Will the project affect ethnographic resources?
** XI.A(1) and (2)–This language about the role of the Field (Regional) Director does not alter the ultimate responsibility assigned to heads of agencies under Section 110(l) of the National Historic Preservation Act in cases where there is an adverse effect that is not covered by an agreement with the Council.

IMPLEMENTING SECTION 106 AND THE 1995 SERVICEWIDE PROGRAMMATIC AGREEMENT WITHIN THE NATIONAL PARK SYSTEM

Purpose

The purpose of this document is to outline the legal and regulatory responsibilities of park superintendents under Section 106 of the National Historic Preservation Act of 1966, and to provide guidance on successful approaches to achieving compliance and avoiding conflict.

Background

Every project that has the potential to affect cultural resources requires compliance with Section 106 and its implementing regulations, 36 CFR Part 800. To facilitate the compliance process by accelerated review of certain specified common activities (programmatic exclusions), the National Park Service negotiated a Programmatic Agreement (PA) with the National Conference of State Historic Preservation Officers (NCSHPO) and the Advisory Council on Historic Preservation (ACHP). Under the terms of this 1995 PA, the National Park Service:

continues to preserve and foster appreciation of park cultural resources in accordance with law, regulations, policies, and the Secretary's Standards; and carries out the process in 36 CFR Part 800 and documents programmatic exclusions under stipulation IV, ensuring review by cultural resource specialists of all actions subject to Section 106; and makes park superintendents the responsible agency officials for 106 purposes, reflecting the new NPS organizational structure and emphasis on de- centralization and teamwork.

The National Conference and the Advisory Council: consult with the NPS in the 36 CFR Part 800 process; and consider invitations to participate in training for park staffs; and respond as they see fit to requests for early participation in park planning; and treat park superintendents as interested parties for actions that may affect parks as noted in stipulation IX.

I. Role and Function of Park Managers and Staff

A. As the responsible agency official for actions in the park, the park superintendent ensures that legal and regulatory requirements of Section 106 and 36 CFR Part 800 are met, including:

identification of actions that have the potential to affect cultural resources;

identification and evaluation of cultural resources that exist in a project area;

evaluation of the potential effects proposed activities may have on resources that meet National Register criteria;

consideration of ways to reduce or avoid harm by federal undertakings to potentially affected resources eligible for the Register; and involvement of and consultation with the public, state historic preservation officers, and the Advisory Council in this process.1

B. Under the 1995 PA, the park superintendent: is the signatory for correspondence and documentation provided to the SHPO and Advisory Council under 36 CFR Part 800, and for documentation of programmatic exclusions in the 1995 PA; designates a park Section 106 coordinator qualified to act as the park's staff contact for the 106 process; identifies and uses a set of cultural resource management (CRM) specialists to advise the park in 106 matters.2 Those specialists' qualifications are consistent with (a) OPM standards, (b) the intent of 36 CFR Part 61, Appendix A, and (c) the intent of Section 112(a)(1)(B) of the National Historic Preservation Act; should inform the appropriate SHPO(s) and regional director about the specialists who will be among the park's advisers; invites the SHPO to meet to discuss the park's compliance efforts every two years; may develop procedures and programmatic approaches to Section 106 that more closely reflect the specific resources and needs of their parks and their working relationships with SHPOs and the Advisory Council; should seek to coordinate Section 106 compliance procedures with existing park project review processes; and has a commitment to make park staff generally familiar with the 106 process.

1 36 CFR Part 800 contains the definitive description of the process, and "Section 106, Step by Step" and other Advisory Council publications provide further guidance in implementing and interpreting the regulations.

2 In many cases a support office will be able to provide expertise not currently available on the park staff. An adjacent park or parks may also have individuals with the necessary qualifications, and expertise outside NPS may be sought. Typically, a park's core group of advisers would include a historical architect, archeologist, historical landscape architect, historian, ethnographer, and curator. Superintendents may also sometimes need to reach beyond the core group for additional specialized expertise. Advisers not on the park staff should have a specified term of commitment to advise the park.

C. The park Section 106 coordinator coordinates and facilitates 106 procedures and works with project initiators, planners, and the park's CRM advisers to: initiate or coordinate (and review if he/she is a cultural resource management specialist) 106 documentation; and seek advice and technical expertise of appropriate CRM advisers/specialists needed in formulating proposals, evaluating properties for National Register eligibility, assessing effects under 36 CFR Part 800,

and consulting on adverse effects and mitigation measures. He or she, optimally, should be a cultural resource management specialist.

II. Section 106 Procedures

As noted in the 1995 PA, the basic process outlined in 36 CFR Part 800 applies to park undertakings, with the exception of those covered as programmatic exclusions by the PA's stipulation IV or otherwise covered by other programmatic 106 documents. Please see "Section 106, Step by Step" and other Advisory Council published guidance for a comprehensive discussion of how to implement the regulatory process. Following are considerations in that process:

A. Project Identification. The park Section 106 coordinator should be consulted by others on the park staff to determine the potential of proposed projects to affect cultural resources.

B. Determination of Undertaking. The park Section 106 coordinator should determine, in consultation with the park's identified CRM advisers and the SHPO as needed, whether a project is to be considered an undertaking as defined in 36 CFR 800.2(0).

C. 106 Documentation. The Section 106 coordinator should ensure that appropriate documentation is prepared in a timely manner, reviewed by relevant CRM specialists, signed by the superintendent, and submitted to the SHPO and Advisory Council on Historic Preservation as required in 36 CFR Part 800. (The National Park Service has traditionally used the Assessment of Effect Form to document the consideration of Section 106 in its activities. A model Assessment of Effect Form is in Appendix O. It can be amended to reflect regional protocols or park or area-specific programmatic agreements with an SHPO and the ACHP.)

D. Consultation. The Section 106 coordinator should facilitate, monitor, and document the progress of consultation with the public, state historic preservation officers, and the Advisory Council, as appropriate.

E. Monitoring. Park staff should provide the Section 106 coordinator with information needed to monitor and ensure the implementation of any conditions or stipulations developed in agreement documents through the Section 106 process. This includes notifying the 106 coordinator if cultural resources are discovered, or if the scope of work is changed, in the course of an undertaking's implementation.

F. Archiving of Documentation. The park Section 106 coordinator should maintain in the park files (file code H4217) all "Assessment of Effect" forms and other 106 documentation, including correspondence, plans, photographs, etc.

III. Communications and Accountability

A. Superintendents' current performance contracts include a section on the park's resources management. Superintendents are responsible within this performance evaluation system for the park's Section 106 compliance activities.
B. Revised NPS procedures for program evaluation will also provide ways to assess the Service's observance of Section 106 compliance procedures.
C. Annual summaries of park compliance activity should be provided to the regional director (and to the Service's federal preservation officer) and may be incorporated into the superintendents' annual reports. (These aggregated summaries allow the regional director and the federal preservation officer to observe broad trends in Section 106 activities and knowledgeably represent the Service at meetings of NPS, NCSHPO, and Advisory Council staff.)
D. Each SHPO will be invited to comment to the superintendent and to the regional director on each park's performance in meeting the responsibility for Section 106 compliance.

# BIOLOGICAL EVALUATION

# for

# WILDLAND FIRE USE

# in

# GRAND CANYON NATIONAL PARK,

# COCONINO COUNTY, ARIZONA

**AUGUST 2002**

**DOCUMENT REVIEW**

Prepared by:_____
Kara Leonard, Fire Ecologist

Approved by:_____
R.V. Ward, Wildlife Biologist

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# I. INTRODUCTION

As part of a comprehensive fire management program, Grand Canyon National Park (GCNP) intends to allow certain naturally-ignited fires to burn in order to achieve resource benefits. The Wildland Fire for Resource Benefits program is described under the 1998 Grand Canyon National Park Fire Management Plan Amendment to the 1995 Fire Management Plan, and in current terminology is known simply as “wildland fire use”. This biological evaluation describes the rationale for including wildland fire use in the park’s fire program, the likely effects of wildland fire use on threatened and endangered species, and the conservation measures that will be implemented by the park to mitigate any negative effects to these species. The full scope of the project will be discussed in the following section.

# I. BACKGROUND INFORMATION AND PROJECT DESCRIPTION

## OVERVIEW OF GRAND CANYON NATIONAL PARK'S NATURAL RESOURCES

Grand Canyon National Park encompasses 1.2 million acres in northern Arizona. Over 1 million acres of the park are proposed for wilderness designation and are managed by the Park Service as if they were designated wilderness. The Grand Canyon region is one of the most ecologically diverse in North America, with five of the seven life zones (Lower Sonoran, Upper Sonoran, Transition, Canadian, and Hudsonian) occurring in the park (National Park Service 1997). Within the inner canyon, at the lowest elevations (below 5000 feet), are several riparian woodland and scrub communities, as well as a variety of warm desert scrub associations with species characteristic of both Sonoran and Mohave deserts. At higher elevations within the canyon, and on the plateaus surrounding the canyon, are several cold desert scrub associations, with species characteristic of Great Basin desert. Interspersed with these communities, and at higher elevations, are pinyon-juniper woodlands (4000 – 7500 feet). Above these are the forest associations, including pure ponderosa pine (7500 – 8000 feet), ponderosa mixed with white fir and other conifers (8000 – 8800 feet), and spruce-fir at the highest elevations (above 8800 feet). Appendix A contains a map of the forest vegetation types. Some grassland communities, including mountain meadows and semi-desert shrub-grasslands, also occur within the park (Warren et al. 1982). The park's broad variety of habitat supports about 1,500 plant species, 340 bird species, 90 mammal species, 60 reptile and amphibian species, and 25 fish species.

## FIRE'S ROLE AT GRAND CANYON NATIONAL PARK

Fire has been a significant influence in the development and maintenance of many of the vegetative communities at Grand Canyon National Park. Over thousands of years, the forests, woodlands, and grasslands have evolved with various fire regimes, most of which have been increasingly altered by human activities. Of the vegetation types in which disturbance patterns have been changed, the forested communities have been among the most severely affected.

Before Euro-American settlement, the lower-elevation conifer forests of the southwest typically experienced frequent, low-intensity surface fires. These fires generally did not harm large trees, but they did limit the survival of seedlings. They also regularly consumed materials on the forest floor, releasing nutrients, and occasionally provided openings for tree regeneration or release. The resulting forests had a diverse, open structure, with little invasion of shade-tolerant understory species (Wolf and Mast 1998).

In general, the fire return interval in southwestern ponderosa forests was 2 to 20 years prior to Euro-American settlement (Fulé et al. 1997). Wolf and Mast (1998) reconstructed long-term fire histories for pre-Euro-American

settlement (prior to 1870), settlement (1870-1919), and fire suppression (1920-1995) eras for the North Rim of Grand Canyon National Park. This study indicated that the fire return interval prior to 1870 ranged from 4.85 years at the lowest elevations to 10.30 years at the highest elevations. Another study conducted in ponderosa and mixed-conifer forest in the park found mean fire return intervals ranging from 2.97 years to 6.54 years, with lower elevation sites experiencing greater fire frequency (Covington et al. 2000). This elevational gradient of increasing fire return interval continues into the highest-elevation spruce-fir forest. These forests may experience some low-intensity fire, but depend more on a low-frequency, high-intensity stand-replacement fire regime for maintenance and renewal (White and Vankat 1993).

When considering fire return intervals, it is important to note that these represent averages across an area. They do not reflect the typically patchy nature of low-intensity fires, in which some areas tend to burn in every fire, while other areas burn only rarely.

Fire regimes throughout the southwest and in the park have been disrupted by a range of human activities, particularly since Euro-American settlement. In the park, one of the most important factors was heavy, unrestricted livestock grazing, which began in the late 1800's (National Park Service 1997). Grazing reduced the fine fuels that had carried the frequent low-intensity fires through the ponderosa forests. Less fire and reduced competition from grasses allowed more young trees to become established. When fire suppression began in the 1920's, these changes were strongly reinforced.

The changes that have occurred due to these disruptions have, in general, been more severe in the sites with the shortest fire return intervals, as more fires have been missed. These forests now have much higher tree density, fuel loads, canopy closure, fuel continuity, and landscape homogeneity than they had in the past (Covington and Moore 1994). This has resulted in decreased diversity, forage production, and nutrient cycling, while increasing the potential for outbreaks of disease and insect infestation. It has also greatly increased the risk of large, severe, stand-replacing wildfires.

Recent very large, high-severity fires throughout the southwest are evidence of the magnitude of the problem. In the park, as elsewhere, forested habitat is at great risk of sudden, rapid loss. Equally at risk are the human developments bordering or surrounded by these forests. For these reasons, fire management at Grand Canyon currently deals almost exclusively with these forested areas.

### OVERVIEW OF FIRE MANAGEMENT PROGRAM

Until 1978, when a prescribed fire program was introduced, fire suppression was the only fire management option for the park. Since that time, the fire

management program has grown, and today involves not only wildfire suppression and prescribed fire, but also wildland fire use (the management of naturally ignited fires), and mechanical treatments in urban interface areas.

A new fire management plan is currently being developed for the park. Until the new plan is completed, the fire management program continues to be guided by the 1992 Wildland Fire Management Plan (National Park Service 1992), which was revised in 1993, 1994, and 1995, and amended in 1998 to address new fire policies and park plans. A biological evaluation was written for the 1992 plan, but that evaluation is now out of date due to various changes, including the listing of the Mexican spotted owl and the designation of its critical habitat. A new consultation with the U.S. Fish & Wildlife Service will be completed for the new fire management plan. This document, covering the wildland fire use portion of the program, will serve as an intermediate step toward that larger consultation.

The goal of the fire management program, as stated in the 1992 Wildland Fire Management Plan, is "to effectively manage wildland fire and provide for the protection of life, property, and cultural resources, while ensuring the perpetuation of park ecosystems and natural resources". This goal is related to, and supports, several of the management objectives outlined in the park's General Management Plan (National Park Service 1995). These include:

- *To the maximum extent possible, restore altered ecosystems to their natural conditions.*
- *Manage ecosystems to preserve critical processes and linkages that ensure the preservation of rare, endemic, and specially protected (threatened/endangered) plant and animal species.*
- *Preserve, protect, and interpret the park's natural and scenic resources and values, and its ecological processes.*
- *Preserve, protect, and improve air quality and related values such as visibility.*
- *Preserve and protect the genetic integrity and species composition within the park, consistent with natural ecosystem processes.*
- *Inventory, monitor, and maintain data on park natural and cultural resources and values, and utilize this information in the most effective ways possible to facilitate park management decisions to better preserve the park.*

The fire management program is also involved in supporting many of the management objectives identified in the park's Resource Management Plan (National Park Service 1997). One of the natural resource objectives stated in this plan relates directly to the fire management program:

- *Reintroduce and maintain fire's natural role in Park ecosystems to the maximum extent possible.*

Other natural resource management objectives that relate to the fire management program are:

- *Through the development and operation of a science-based comprehensive natural resource inventory and monitoring program, develop and maintain an understanding of the status and trends of populations, communities, and ecosystems, and the phenology of the resource.*
- *Restore, enhance, and protect populations of threatened or endangered species.*
- *Preserve the natural genetic integrity and species composition within the Park, consistent with ecosystem processes, including the elimination of nonnative plant and animal species wherever possible.*
- *Preserve air quality, and protect it from within-Park, as well as, external degradation. Work toward continued protection of Grand Canyon's Class I airshed.*
- *Protect and conserve sources and quality of natural water resources.*

To meet these objectives, the fire management program employs all of the tools available to fire managers -- fire suppression, prescribed fire, wildland fire use, and limited mechanical thinning. All of these activities can be useful in fulfilling these objectives, but they also have the potential to work against many of the same objectives. In almost all situations, the fire management program must carefully balance the positive and negative effects of fire and fire management activities.

In order to determine if the program is successfully achieving this balance and meeting objectives, the fire management program includes a monitoring program. According to the National Park Service Reference Manual 18 (National Park Service 1999), which provides guidance on wildland fire management, all National Park Service units using prescribed fire must implement a standardized vegetation monitoring program to track fire effects and to ensure that fire management resource objectives are met. The fire effects monitoring program at Grand Canyon began in 1989 and has a current network of over 100 permanent plots stratified by seven vegetation types. Plots are visited pre-burn, post-burn, and one, two, and five years after prescribed fires, and when possible, after wildland fire use fires. Overstory and pole-sized trees, seedlings, shrubs, herbaceous vegetation, and fuel loading are measured. Detailed monitoring protocols are outlined in the NPS Fire Monitoring Handbook, which can be found at: **www.nps.gov/fire/fmh/FEMHandbook.pdf**.

Fire monitoring efforts have also recently expanded to include burn severity mapping using satellite imagery, which helps us gain a broader view of fire effects across each project area. A satellite view of a recently burned area is acquired and the view is classified into areas of different burn severity. The burn severity classes are defined as follows:

***Unburned***: *No evidence of fire.*

***Low***: *Fire was nonlethal to the dominant vegetation. Fire did not alter the structure of the dominant vegetation. Scattered small, unburned patches intermixed within burn area. Scorching of vegetation limited to 1 meter high or less. Small organic material on ground scorched, but not entirely consumed. Most foliage and twigs intact. Mineral soil intact.*

***Low-to-Moderate***: *Partial scorching of foliage and fine materials on vegetation. Minimal consumption of foliage and fine materials on vegetation. Most overstory green vegetation remains. Limited overstory tree mortality. Few, if any, unburned patches within the burn area. Most fine organic materials partially consumed, with minimal consumption of large logs. Rotten wood scorched to partially burned. Mineral soil generally intact.*

***Moderate-to-High***: *Fire scorched most of the foliage and fine materials on vegetation. Partial consumption of foliage and fine materials on vegetation. Limited green vegetation remains in overstory. Partial overstory tree survival expected. Intermittent patches within burn area have large logs as well as all organic materials consumed to bare mineral soil. Most woody debris consumed. Mineral soil partially altered.*

***High***: *Fire killed above ground parts of all vegetation, changing the forest structure substantially. All foliage and fine materials on vegetation consumed. Most large logs as well as all organic material on the ground consumed. All forest litter and duff consumed, exposing and altering bare mineral soil.*

Next, ground-truthing is conducted to determine the accuracy of the classification. We have found that the classification method accurately predicts the burn severity observed on the ground. This allows us to use the satellite image to quantify areas of different burn severity within the burn. An example of the results is shown in the map of the Vista fire in Appendix B, and more information on the process can be found at: **http://edc2.usgs.gov/fsp/severity/fire_main.asp**.

We are also considering additional ways to expand the monitoring program and to continue improve our ability to answer questions about fire at Grand Canyon, and to better understand fire ecology at a landscape scale.

Issues of scale have become increasingly important to fire managers in recent years. The occurrence of many large, severe wildfires has underscored the need to find ways to apply fuel reduction treatments at the scale needed to reduce hazards over large areas.

This is as true at Grand Canyon as it is elsewhere. Park management plans have stated goals of restoring altered ecosystems to their natural conditions, preserving critical ecosystem processes, and reintroducing and maintaining fire's natural role in park ecosystems to the maximum extent possible (National Park Service 1995 and 1997). The park has over 120,000 acres of forested habitat; most of these acres are not yet in a condition where a natural fire regime can safely be allowed to resume. Currently, we are not treating enough acres annually to achieve that ultimate goal, and to protect our forests adequately from catastrophic fire. To date, the largest acreage treated within a single year in the park, wildfires excluded, was just over 11,000 acres, which occurred in 1998 and also in 2001 (GCNP fire records, on file at GCNP fire offices). As an example, to simulate a mid-range historical fire return interval of 6 years, an average of 20,000 acres would need to be treated each year. Even achieving a longer fire return interval of 20 years would require that an average of 6000 acres be treated annually; we have achieved that level of treatment in only two additional years. One of the most promising methods for efficiently and cost effectively increasing the number of successfully treated acres is the application of wildland fire use, or the management of naturally ignited fires.

**WILDLAND FIRE USE PROGRAM: PROJECT DESCRIPTION**

Wildland fire use, which used to be known as prescribed natural fire, is the practice of allowing naturally ignited fires to continue to burn in order to meet resource management goals. Wildland fire use fires can receive a varying degree of management as needed, ranging from simply monitoring the fire's progress to full suppression. Fire managers can also apply a combination of management techniques on different parts of a single fire.

The decision to let a natural ignition burn as a wildland fire use fire is made by the park superintendent, using information and analysis provided fire managers and resource managers. An interdisciplinary team is formed to make decisions on whether or not the fire will provide resource benefits, to define risks to resources, to establish boundaries for the fire (called Maximum Manageable Areas, or MMAs), and to reevaluate the progress of the fire on a continuing basis. A complete description of this analysis and management process can be found in the Wildland and Prescribed Fire Management Policy Implementation Reference Guide, which can be found at: **www.fs.fed.us/fire/fire_new/fireuse/wildland_fire_use/ref_guide/**. That document is a supporting document for the Federal Wildland Fire Management Policy, which can be found at: **www.nifc.gov/fire_policy/index.htm**.

Among the changes made in the 1998 amendment to the park's fire management plan was the division of the park into 3 Fire Management Zones by grouping similar fuel types: Grass-Brush-Pinyon-Juniper, Ponderosa Pine, and Mixed Conifer. The Grass-Brush-Pinyon-Juniper Fire Management Zone includes the inner canyon from Grand Wash Cliffs to Lees Ferry, up to the Coconino geologic formation. It also includes plateau areas of the South Rim from Hermit's Rest west to the Great Thumb, and from the Coconino Rim east to Desert View. It also includes Powell Plateau, and it encompasses approximately 1,015,000 acres. The Ponderosa Pine Fire Management Zone includes areas of the South Rim from Hermits Rest east to the Coconino Rim, as well as that area in and around Mt. Emma bounded on the north and west by the park boundary and on the east and south by the Tuweep Valley. It encompasses approximately 35,000 acres. The Mixed Conifer Fire Management Zone includes the entire North Rim from Cape Royal west to Fire Point, and encompasses approximately 150,000 acres.

The fire management plan allows for suppression, prescribed fire, and wildland fire use in each of these zones. However, because the current extent of the wildland fire use program is limited to forested areas, we will limit our evaluation and consultation to wildland fire use in forested areas as well. The Ponderosa Pine and Mixed Conifer Fire Management Zones include these areas and are shown in a project area map in Appendix C.

The Mixed Conifer Fire Management Zone on the North Rim will present the greatest number of opportunities for wildland fire use. The more developed

nature of the South Rim allows fewer opportunities for wildland fire use in the Ponderosa Pine Fire Management Zone, but it is a possibility, especially in the portion of the Zone in and around Mt. Emma. The greatest number of potential wildland fire use ignitions will be due to lightning strikes during the monsoon season of July and August (Wolf and Mast 1998). Likely ignition locations are well-distributed, but starts may be more common at the southern tips of the North Rim plateaus. The historical ignition pattern map in Appendix D shows the distribution of lightning-caused fires.

In order to achieve the desired resource benefits, wildland fire use fires must remain primarily low-intensity fires, with only scattered high intensity patches within the perimeter of the fire. Low intensity, in a general sense, means that the fire will remain a surface fire, moving into the crowns of mature trees only occasionally. It will not be a stand-replacing fire. The fire will thin smaller trees, reduce available fuels, and release nutrients, and will cause little, if any, damage to the largest trees. Fire managers and resource managers will work together to decide whether any individual fire is meeting this description and helping to meet the resource management goal of reintroducing and maintaining fire's natural role in the park's ecosystems.

For the most part, management of these fires will be relatively unobtrusive, with a few personnel visiting the fire on a regular basis to monitor its behavior and progress. However, if monitoring indicates that the fire is not achieving the desired resource benefits, the decision may be made to suppress the fire, in whole, or in part. If suppression actions become necessary, greater levels of activity and habitat disturbance will also be necessary. Suppression activities could include fireline construction, helicopter water drops, aerial application of retardant, or other suppression activities.

### GENERAL RESOURCE PROTECTION AND CONSERVATION MEASURES FOR THE WILDLAND FIRE USE PROGRAM

In order to ensure that the effects of the wildland fire use program on park resources are positive, we will employ the general resource protection and conservation measures described below.

#### *Using only low intensity fires for wildland fire use*

As discussed above, wildland fire use fires must remain at primarily low intensity, with only scattered high intensity patches, to be allowed to continue as a wildland fire use fire.

#### *Monitoring fire effects for adaptive management*

We will monitor the effects of the wildland fire use fires we propose to conduct in order to provide the information necessary to allow adaptive management. Our efforts will include monitoring fire behavior while fires are

ongoing and providing feedback to fire managers. We will also include long-term monitoring through the existing fire effects program to the greatest extent possible. We will also include remotely sensed burn severity monitoring, and may introduce new methods as necessary.

### *Reporting results to U.S. Fish and Wildlife Service*

We will collect information to provide to U.S. Fish and Wildlife Service on possible effects to threatened and endangered species and their habitat. Our reporting will include notification that a wildland fire use project is occurring, brief progress reports if desired, and a report at the conclusion of each fire event.

We will maintain a record of fire-related activities of interest to the Service. Resource advisors will collect information including: fire size; numbers of personnel present; fireline length; estimated number of total trees and snags cut; estimated number of large (>18" DBH) trees and snags cut; location of new fire support sites such as camps, helispots, and drop points; amount and type of disturbance involved in construction of fire support sites; types of aircraft used; number of flights over and around the incident; and number, size, and location of water drops. We will also provide any available information on fire behavior and fire effects as needed, including fire effects monitoring data, fire effects plot data and burn severity data. An analysis of the effects of the fire on threatened and endangered species and their habitats will also be provided.

### *Planning to minimize negative impacts*

Minimizing the need for suppression activities, both planned and unplanned, is critical to maximizing positive effects and minimizing negative effects of wildland fire use projects. In order to do this, the boundaries, or Maximum Manageable Areas, of wildland fire use projects must be placed where they can most successfully be defended. Boundaries must also be set so that overall size of the project area is appropriate to resource availability. Project size must also reflect resource objectives as decided by the interdisciplinary team.

Because it is so important that MMAs be defensible, they will not always be able to be fine-tuned to avoid sensitive resource areas. In some cases, the boundary will be placed to avoid a large sensitive area. More commonly, plans will be made to protect areas that fall within the MMA. When such an area is identified by the interdisciplinary team, we will plan protection activities for that area, and we will establish trigger points that will indicate when those protection activities should take place. These trigger points can be defined in various ways; they may relate to a point on the ground, or a point in time, or a level of disturbance.

Finally, whenever fire suppression activities are necessary, we will employ Minimum Impact Suppression Tactics (MIST) (Appendix E) in order to minimize negative effects. Additional park-specific resource protection guidelines (Appendix F) will be provided to fire personnel, and specific direction to fire personnel will be provided by a resource advisor familiar with the park's resource issues.

### *Adherence to conservation measures*

The conservation measures in Appendices E and F are considered to be part of the project description for all wildland fire use fires, as are the conservation measures for individual species described later in this document. They are not considered optional or discretionary, except in rare instances where adherence to those measures would compromise safety.

## II. THREATENED AND ENDANGERED SPECIES THAT MAY OCCUR IN THE PROJECT AREA

Nine federally listed animal and plant species are known to occur in, or might occur in, Grand Canyon National Park. These are as follows:

### ENDANGERED

- Sentry milk-vetch (*Astragalus cremnophylax var. cremnophylax*)
- Brady pincushion cactus (*Pediocactus bradyi)*
- Kanab ambersnail (*Oxyloma haydeni kanabensis*)
- Humpback chub (*Gila cypha*)
- Southwestern willow flycatcher (*Empidonax traillii extimus*)

### THREATENED

- Bald eagle (*Haliaeetus leucocephalus*)
- Desert tortoise (*Gopherus agassizii*)
- Mexican spotted owl (*Strix occidentalis lucida*)

### EXPERIMENTAL POPULATION (TREATED AS THREATENED IN NATIONAL PARKS)

- California condor (*Gymnogyps californianus*)

The remainder of this biological evaluation will discuss the potential effects of the wildland fire use program on the threatened and endangered species and critical habitat found in the park. For each species, we will discuss the range of possible effects to the species, as well as the conservation measures that we will follow to protect each species.

# III. SENTRY MILK-VETCH

## BACKGROUND

*Astragalus cremnophylax var. cremnophylax* is a dwarf milk-vetch that is endemic to at least 7 sites on the South Rim of Grand Canyon National Park and four sites on the North Rim. The U.S. Fish and Wildlife Service designated it as endangered throughout its range in 1990 (U.S. Fish and Wildlife Service 1990). The plant occurs in crevices and depressions with shallow soils on Kaibab limestone on a broad platform at the rim of the Grand Canyon. This milk-vetch apparently prefers the unshaded, well-drained soils or limestone pavement in openings in the pinyon-juniper woodland. The plant appears to occur on one specific layer of Kaibab limestone where the limestone forms a minimum-sized bench or "patio." Dominant species in the surrounding community include *Petrophytum caespitosum* (rock-mat), *Pinus edulis* (pinyon pine), *Juniperus osteosperma* (Utah juniper), *Cercocarpus intricatus* (little-leaf mountain mahogany), *Ephedra viridis* (Mormon tea), *Purshia mexicana* (cliffrose), *Artemesia bigelovii* (sagebrush), *Agropyron smithii* (wheatgrass), and *Poa pratensis* (bluegrass). Sentry milk vetch and rock-mat are the two dominant species in the dwarf plant community that occurs on this limestone pavement (U.S. Fish and Wildlife Service 1990).

*Astragalus cremnophylax var. cremnophylax* is usually less than 2.5 cm (1 inch) high and forms a mat 2.5-25 cm (1-10 inches) in diameter. The short, creeping stems have compound leaves less than 1.0 cm (0.4 inches) long composed of 5--9 tiny leaflets. The fruit is obliquely egg-shaped and densely hairy. Whitish or pale purple flowers are 0.5 cm (0.2 inches) long and appear from late April to early May. Seeds are set in late May to June. The plants appear to be long-lived and have a thick taproot that penetrates the limestone surface to reach a more constant source of moisture (U.S. Fish and Wildlife Service 1990).

## SENTRY MILK-VETCH SURVEYS IN GRAND CANYON NATIONAL PARK

A thorough count of all South Rim plants in 1988 indicated that the population contained 489 plants. A 1989 inventory of the monitoring plots established in 1988 indicated that the population declined by about 10 percent. Data indicate the cause for this decline may have been trampling by park visitors. The effects of trampling on both plants and their habitat may have been amplified by the below average rainfall in 1989. From May 1989 to May 1990, subpopulations experienced from 19 percent to 63 percent mortality, depending on degree of human visitation (U.S. Fish and Wildlife Service 1990).

In 1988, the seedling class comprised only 22.2 percent of the population. Given the trampled condition of most mature plants, a likely explanation for the small proportion of seedlings is that they are killed by trampling. Only those seedlings in sites relatively safe from trampling survive. Poor seed

dispersal may also affect the number of seedlings (U.S. Fish and Wildlife Service 1990). The NPS has rerouted foot traffic and constructed a rail fence around one South Rim sentry milk-vetch population, in an effort to protect the plants from trampling.

In 1994 an additional four populations of sentry milk-vetch were located in the Cape Final area of Grand Canyon's Walhalla Plateau (Unpublished report in GCNP Botanist files). Total population for the four sites is over 1000 plants. In 1998, all other suitable habitat on the Walhalla Plateau was surveyed with negative results. In 2002 an additional seven populations were located in the Grandview area of the South Rim.

#### CONSERVATION MEASURES FOR SENTRY MILK-VETCH AND ITS HABITAT

The following conservation measures have been adopted as part of the project description, and will be adhered to during project operations, **unless such adherence compromises safety**.

- No wildland fire use fires, and no firefighting (or firefighting-related) activities, will be allowed to encroach upon any known sentry milk-vetch population.
- If unsurveyed areas of potential habitat are included within the project boundary for a wildland fire use fire, we will evaluate the potential for fire to enter the habitat. If it appears that fire could move through the potential habitat, we will survey this habitat before fire reaches it. Fire will not be allowed to enter any habitat found to be occupied.

#### EFFECTS OF THE PROPOSED ACTION ON SENTRY MILK-VETCH AND ITS HABITAT

Because this plant occurs in openings in a vegetation type which is unlikely to carry fire, the potential for affecting sentry milk-vetch populations should be extremely small. However, unsurveyed habitat does exist, and it may be possible for a wildland fire use fire to burn into potential habitat in some situations. For that reason, it is our conclusion that the wildland fire use program may affect the sentry milk-vetch, but is unlikely to adversely affect it.

#### POTENTIAL FOR CUMULATIVE EFFECTS OF NON-FEDERAL ACTIONS TO SENTRY MILK-VETCH OR ITS HABITAT.

We are aware of no non-federal actions that would cause cumulative effects to the sentry milk-vetch or its habitat.

# V. BRADY PINCUSHION CACTUS

## BACKGROUND

The Brady pincushion cactus is an inconspicuous plant with a short (3.8-6.2 cm tall), usually solitary, rounded stem. It blooms in April, and may retract into the ground in the dry season. It is restricted to a specific and limited limestone soil type (Kaibab limestone chips overlying Moenkopi shale and sandstone-derived soils) which occurs on benches and terraces in the Marble Gorge area of northern Arizona. Other plants which share its desert habitat include shadscale (*Atriplex confertifolia*), snakeweed (*Gutierrezia sarothrae*), and Mormon tea (*Ephedra viridis*). Its elevational range is 1170 m to 1370 m. It is threatened by off-road vehicle traffic, pesticides, and illegal collection, and was designated as endangered in 1979 (NatureServe Explorer 2001).

## CONSERVATION MEASURES FOR BRADY PINCUSHION CACTUS AND ITS HABITAT

No conservation measures are necessary, as no wildland fire use activities or effects will be occurring in or near Brady pincushion cactus habitat.

## EFFECTS OF THE PROPOSED ACTION ON BRADY PINCUSHION CACTUS AND ITS HABITAT

We are not currently including any type of desert scrub habitat in our wildland fire use program. Wildland fire use activities in other types of habitat do not have the potential to escape into or to otherwise affect the habitat of the Brady pincushion cactus. Therefore, it is our conclusion that the wildland fire use program will have no effect on the Brady pincushion cactus.

## POTENTIAL FOR CUMULATIVE EFFECTS OF NON-FEDERAL ACTIONS TO BRADY PINCUSHION CACTUS OR ITS HABITAT

We are aware of no non-federal actions that would cause cumulative effects to the Brady pincushion cactus or its habitat.

# VI. KANAB AMBERSNAIL

## BACKGROUND

The Kanab ambersnail (*Oxyloma haydeni kanabensis*) is a rare endemic snail restricted to permanently wet areas within small wetlands of the Colorado Plateau. It is a terrestrial snail in the family Succineidae. The empty shell is a light amber color. The live snail has a mottled grayish-amber to yellowish-amber colored shell. The shell is dextral (right handed spiral), thin-walled, with an elevated spire and a broad, expanded aperture. Fully mature individuals are about 14 to 19 mm (0.5 to 0.75 inch) long, 7 to 9 mm (0.25 to 0.33 inch) in diameter, with 3.25 to 3.75 whorls in a drawn out spire. Its eyes are borne at the ends of long peduncles (stalks), while the tentacles are reduced to small protuberances at the base of the eye stalks (U.S. Fish and Wildlife Service 1995c).

Three populations are known, two in southern Utah, the other within the Grand Canyon of Arizona. A final rule listing the Kanab ambersnail as an endangered species under the authority of the Endangered Species Act, as amended, was published on April 17, 1992 (U.S. Fish and Wildlife Service 1995c).

## KANAB AMBERSNAIL SURVEYS IN GRAND CANYON NATIONAL PARK

The Arizona population occurs in a spring fed wetland at Vasey's Paradise, about 32 river miles downstream from Lee's Ferry in Coconino County. The Arizona population at Vasey's Paradise was discovered in 1991. In 1995, the population size at that site was estimated to be around 106,000 individuals (National Park Service 1997).

The snail also occurs in two other locations within the park, as shown in the map in Appendix G.

## CONSERVATION MEASURES FOR THE KANAB AMBERSNAIL AND ITS HABITAT

The fact that wildland fire use fires will only be allowed to progress if they are primarily low intensity fires will minimize the possibility of excessive erosion. In the unlikely event that wildland fire use activities should result in conditions which could cause increased erosion and siltation of ambersnail habitat, measures will be taken to prevent excessive erosion.

## EFFECTS OF THE PROPOSED ACTION ON THE KANAB AMBERSNAIL AND ITS HABITAT

As the snail's habitat is not near any potential wildland fire use project areas, the potential for any effects of any sort is very small. A possible effect would be increased siltation of ambersnail habitat caused by increased erosion following fire. However, this is unlikely to be a problem, because the overall low intensity of wildland fire use fires will be unlikely to result in erosion problems, and because these fires will be occurring at a distance from snail habitat. In the event that erosion problems became likely for whatever

reason, we would then mitigate the negative effects through erosion control measures. Because negative effects are so unlikely, we conclude that the wildland fire use program may affect, but is not likely to adversely affect the Kanab ambersnail.

### POTENTIAL FOR CUMULATIVE EFFECTS OF NON-FEDERAL ACTIONS TO THE KANAB AMBERSNAIL

We are aware of no non-federal actions that would cause cumulative effects to the Kanab ambersnail or its habitat.

# VII. HUMPBACK CHUB

## BACKGROUND

The humpback chub was listed as an endangered species on March 11, 1967. Humpback chub are found in river canyons, where they use a variety of habitats, including pools, riffles, and eddies. They are endemic to the Colorado River basin, with the largest population occurring in the Little Colorado and Colorado Rivers in the Grand Canyon. They are also found in the Black Rocks/Westwater Canyon and Cataract Canyon of the Colorado River, Desolation and Gray Canyons of the Green River, and Yampa and Whirlpool Canyons in Dinosaur National Monument, Green and Yampa Rivers (U.S. Fish and Wildlife Service 1994b).

Humpback chub in reproductive condition are usually captured in May, June, or July, and spawning occurs soon after the highest spring flows when water temperatures approach 20°C (68°F). Spring flows and proper temperatures are important for humpback chub; flow reductions and low water temperatures in the Grand Canyon have been identified as factors curtailing successful spawning of the fish and increasing competition from other species (U.S. Fish and Wildlife Service 1994b).

## HUMPBACK CHUB SURVEYS IN GRAND CANYON NATIONAL PARK

Surveys and studies of the humpback chub in the park date back at least into the 1970's, and monitoring has been conducted on a more continuous basis since 1990. The largest population of humpback chub in the canyon are found in and near the Little Colorado River, with smaller groups in scattered locations in the Colorado River both upstream and downstream from the Little Colorado (pers. comm., Lew Coggins, fisheries biologist, Grand Canyon Monitoring and Research Center).

## CONSERVATION MEASURES FOR THE HUMPBACK CHUB AND ITS HABITAT

The fact that wildland fire use fires will only be allowed to progress if they are primarily low intensity fires will minimize the possibility of excessive erosion. In the unlikely event that wildland fire use activities should result in conditions which could cause increased erosion and siltation of humpback chub habitat, measures will be taken to prevent excessive erosion.

## EFFECTS OF THE PROPOSED ACTION ON HUMPBACK CHUB AND ITS HABITAT

As the humpback chub's habitat is not near any potential wildland fire use project areas, the potential for any effects of any sort is very small. A possible effect would be increased siltation of humpback chub habitat caused by increased erosion following fire. However, this is unlikely to be a problem, because the overall low intensity of wildland fire use fires will be unlikely to result in erosion problems, and because these fires will be occurring at a

distance from humpback chub habitat. In the event that erosion problems became likely for whatever reason, we would then mitigate the negative effects through erosion control measures. Because negative effects are so unlikely, we conclude that the wildland fire use program may affect, but is not likely to adversely affect the humpback chub.

#### POTENTIAL FOR CUMULATIVE EFFECTS OF NON-FEDERAL ACTIONS TO HUMPBACK CHUB

We are aware of no non-federal actions that would cause cumulative effects to the humpback chub or its habitat.

# VIII. HUMPBACK CHUB CRITICAL HABITAT

## BACKGROUND

The final rule designating critical habitat for the humpback chub was published on March 21, 1994. Known constituent elements for critical habitat include water, physical habitat, and biological environment as required for each particular life stage for each species (U.S. Fish and Wildlife Service 1994b).

## HUMPBACK CHUB CRITICAL HABITAT IN GRAND CANYON NATIONAL PARK

The final rule describes the Arizona portion of humpback chub critical habitat as follows:

> *Arizona: Coconino County. The Little Colorado River from river mile 8 in T.32N., R.6E., sec. 12 (Salt and Gila River Meridian) to the confluence with the Colorado River in T.32N., R.5E., sec. 1 (Salt and Gila River Meridian).*
>
> *Arizona: Coconino County. The Colorado River from Nautiloid Canyon in T.36N., R.5E., sec. 35 (Salt and Gila River Meridian) to Granite Park in T.30N., RIOW., sec. 25 (Salt and Gila River Meridian).*

## CONSERVATION MEASURES FOR THE HUMPBACK CHUB AND ITS HABITAT

The fact that wildland fire use fires will only be allowed to progress if they are primarily low intensity fires will minimize the possibility of excessive erosion. In the unlikely event that wildland fire use activities should result in conditions which could cause increased erosion and siltation of humpback chub critical habitat, measures will be taken to prevent excessive erosion.

## EFFECTS OF THE PROPOSED ACTION ON HUMPBACK CHUB AND ITS HABITAT

As the humpback chub's critical habitat is not near any potential wildland fire use project areas, the potential for any effects of any sort is very small. A possible effect would be increased siltation of humpback chub critical habitat caused by increased erosion following fire. However, this is unlikely to be a problem, because the overall low intensity of wildland fire use fires will be unlikely to result in erosion problems, and because these fires will be occurring at a distance from snail habitat. In the event that erosion problems became likely for whatever reason, we would then mitigate the negative effects through erosion control measures. Because negative effects are so unlikely, we conclude that the wildland fire use program may affect, but is not likely to adversely affect humpback chub critical habitat.

## POTENTIAL FOR CUMULATIVE EFFECTS OF NON-FEDERAL ACTIONS TO HUMPBACK CHUB

We are aware of no non-federal actions that would cause cumulative effects to humpback chub critical habitat.

# IX. SOUTHWESTERN WILLOW FLYCATCHER

## BACKGROUND

On March 29, 1995, the southwestern willow flycatcher (*Empidonax traillii extimus*) was designated as endangered in its entire range, which is known to include Arizona, California, Colorado, New Mexico, Texas, Utah, and Mexico. The southwestern willow flycatcher is a small bird, approximately 15 centimeters (cm) (5.75 inches) long. It has a grayish-green back and wings, whitish throat, light grey-olive breast, and pale yellowish belly. Two wingbars are visible; the eye ring is faint or absent. The upper mandible is dark, the lower is light. The song is a sneezy ''fitz-bew'' or ''fit-za-bew,'' the call a repeated ''whitt.'' The southwestern willow flycatcher occurs in riparian habitats along rivers, streams, or other wetlands, where dense growths of willows (*Salix* sp.), *Baccharis* sp., arrowweed (*Pluchea* sp.), buttonbush (*Cephalanthus* sp.), tamarisk (*Tamarix* sp.), Russian olive (*Eleagnus* sp.) or other plants are present, often with a scattered overstory of cottonwood (*Populus* sp.) (U.S. Fish and Wildlife Service 1995b). Throughout the range of *E. t. extimus*, these riparian habitats tend to be rare, widely separated, small and/or linear locales, separated by vast expanses of arid lands.
The southwestern willow flycatcher has experienced extensive loss and modification of this habitat and is also endangered by other factors, including brood parasitism by the brown-headed cowbird (*Molothrus ater*) (U.S. Fish and Wildlife Service 1995b).

## SOUTHWESTERN WILLOW FLYCATCHER SURVEYS IN GRAND CANYON NATIONAL PARK

In both 2001 and 2002 Grand Canyon Monitoring and Research Center crews located a single pair of southwestern willow flycatchers between river mile 50.5 and 51.5. All other sites were negative. In 2000 four adults were observed at river mile 246.

## CONSERVATION MEASURES FOR THE SOUTHWESTERN WILLOW FLYCATCHER AND ITS HABITAT

As no wildland fire use activities are currently planned for flycatcher habitat, and planned activities will be quite distant from flycatcher habitat, the possible effect of smoke is the only effect requiring conservation measures.

The park is a Mandatory Federal Class I area for air quality under the Clean Air Act, making the park, and fire management, subject to stringent air quality standards set by the Arizona Department of Environmental Quality (ADEQ). Amounts of smoke which would be associated with a violation of the ADEQ standards would also be likely to pose risks for visitors, and by extension, to wildlife. Because such a violation would be a serious problem for the park, every effort is made to avoid this during any prescribed fire or wildland fire use operation. First, such operations are only conducted when

weather forecasts and current conditions indicate that smoke will be carried up and away from the canyon on the prevailing southwest winds. Second, various methods of air quality monitoring (dataRAM particulate monitors, transmissometers, photo points) are employed at several locations in Grand Canyon during such operations. The data collected is analyzed on a continuous basis and the results are passed on to fire managers and to ADEQ. If an impending violation is detected, fire managers will adjust management strategies to reduce smoke production and avoid the violation. These measures will help protect the flycatcher from negative effects from smoke.

#### EFFECTS OF THE PROPOSED ACTION ON THE SOUTHWESTERN WILLOW FLYCATCHER AND ITS HABITAT

The possibility of direct effects from wildland fire use fires on either the southwestern willow flycatcher or their riparian habitat is extremely remote as the project area on both rims is greatly separated from any suitable habitat. A small possibility does exist of indirect effects from smoke reaching the inner canyon. We conclude that wildland fire use fires may affect the southwestern willow flycatcher, but are unlikely to adversely affect it.

#### POTENTIAL FOR CUMULATIVE EFFECTS OF NON-FEDERAL ACTIONS TO THE SOUTHWESTERN WILLOW FLYCATCHER

We are aware of no non-federal actions that would cause cumulative effects to the southwestern willow flycatcher or its habitat.

# X. SOUTHWESTERN WILLOW FLYCATCHER CRITICAL HABITAT

## BACKGROUND

The U.S. Fish & Wildlife Service designated critical habitat for the southwestern willow flycatcher on August 21, 1997. The designation included 964 river miles in 18 separate critical habitat units in Arizona, New Mexico, and California.

The physical and biological features and primary constituent elements of this critical habitat are provided or will be provided by dense thickets of riparian shrubs and trees (native and exotic species). This vegetation, by definition, occurs near rivers, streams, open water, cienegas, marshy seeps, or saturated soil. Constituent elements of critical habitat include the riparian ecosystem within the 100-year floodplain, including areas where dense riparian vegetation is not present, but may become established in the future (U.S. Fish and Wildlife Service 1997).

## SOUTHWESTERN WILLOW FLYCATCHER CRITICAL HABITAT IN GRAND CANYON NATIONAL PARK

The critical habitat unit which includes part of the park is defined as follows:

> *Colorado River, Coconino County: from river mile 39 (T35N, R5E, Section 16) downstream to river mile 71.5 (T31N, R5E Section 8). (River mile 0 = Lee's Ferry). Approximately 52 km (32 miles). The boundaries include areas within the 100-year floodplain where thickets of riparian trees and shrubs occur or may become established as a result of natural floodplain processes or rehabilitation* (U.S. Fish and Wildlife Service 1997).

## CONSERVATION MEASURES FOR SOUTHWESTERN WILLOW FLYCATCHER CRITICAL HABITAT

No wildland fire use activities are currently planned for any southwestern willow flycatcher habitat of any type. All planned activities will be quite distant (at least 3, and usually 5 or more miles) from the critical habitat unit. For these reasons, no conservation measures are necessary.

## EFFECTS OF THE PROPOSED ACTION ON SOUTHWESTERN WILLOW FLYCATCHER CRITICAL HABITAT

Because no wildland fire use activities are currently planned for any southwestern willow flycatcher critical habitat, and all planned activities will be quite distant from the critical habitat unit, we conclude that wildland fire use activities will have no effect on southwestern willow flycatcher critical habitat.

## POTENTIAL FOR CUMULATIVE EFFECTS OF NON-FEDERAL ACTIONS ON SOUTHWESTERN WILLOW FLYCATCHER CRITICAL HABITAT

We are aware of no non-federal actions that would cause cumulative effects to southwestern willow flycatcher critical habitat.

# XI. BALD EAGLE

### BACKGROUND

The bald eagle is the only eagle unique to North America. It ranges over most of the continent, living near rivers, lakes, marshes and other wetlands. Males weigh 7 to 10 pounds and have a wingspan of over 6 feet; females weigh up to 14 pounds and have a wingspan of up to 8 feet. Bald eagles commonly eat fish, but will also eat ducks, rodents, snakes, and carrion (U.S. Fish and Wildlife Service 1995a).

Bald eagles have received some type of legal protection in the U.S. since 1940 in an attempt to protect them from various threats, including habitat loss, illegal shooting, and DDT contamination. Recovery efforts have been successful. In 1995, the species' status in the lower 48 states was changed from endangered to threatened (U.S. Fish and Wildlife Service 1995a).

### BALD EAGLE SURVEYS IN GRAND CANYON NATIONAL PARK

The bald eagle does not nest in Grand Canyon and would occur in the project area only as a spring and fall transient migrant and a winter resident.

### CONSERVATION MEASURES FOR THE BALD EAGLE AND ITS HABITAT

The possible effect of smoke is the only effect requiring conservation measures. The park is a Mandatory Federal Class I area for air quality under the Clean Air Act, making the park, and fire management, subject to stringent air quality standards set by the Arizona Department of Environmental Quality (ADEQ). Amounts of smoke which would be associated with a violation of the ADEQ standards would also be likely to pose risks for visitors, and by extension, to wildlife. Because such a violation would be a serious problem for the park, every effort is made to avoid this during any prescribed fire or wildland fire use operation. First, such operations are only conducted when weather forecasts and current conditions indicate that smoke will be carried up and away from the canyon on the prevailing southwest winds. Second, various methods of air quality monitoring (dataRAM particulate monitors, transmissometers, photo points) are employed at several locations in Grand Canyon during such operations. The data collected is analyzed on a continuous basis and the results are passed on to fire managers and to ADEQ. If an impending violation is detected, fire managers will adjust management strategies to reduce smoke production and avoid the violation. These measures will help protect bald eagles from any negative effects from smoke.

### EFFECTS OF THE PROPOSED ACTION ON THE BALD EAGLE AND ITS HABITAT

While the birds might encounter smoke from a wildland fire use fire, the possibility is remote, and the ease of avoidance and the availability of other

habitat would make any effects insignificant. We conclude that the wildland fire use program may affect, but is unlikely to adversely affect, the bald eagle.

### POTENTIAL FOR CUMULATIVE EFFECTS OF NON-FEDERAL ACTIONS TO THE BALD EAGLE

We are aware of no non-federal actions that would cause cumulative effects to the bald eagle or its habitat.

# XII. DESERT TORTOISE

## BACKGROUND

On August 20, 1980, the Service listed the Beaver Dam Slope population of the desert tortoise (Gopherus agassizii), in southwestern Utah, as a threatened species and designated 35 square miles of critical habitat. On September 14, 1984, the Service received a petition from the Environmental Defense Fund, Natural Resources Defense Council, and Defenders of Wildlife to list the desert tortoise in Arizona, California, and Nevada as endangered. In September 1985, the Service determined that the listing was warranted but precluded by other listing actions of higher priority under authority of section 4(b)(3)(iii) of the Act. The Service made annual findings of warranted but precluded from 1985 through 1989 under section 4(b)(3)(C) of the Act. On May 31, 1989, the same three environmental organizations provided substantial new information and petitioned the Service to list the desert tortoise as endangered throughout its range in the United States under the expedited emergency provisions of the Act. As a result of the new information, on August 4, 1989, the Service listed the Mojave population, excluding the Beaver Dam Slope population in Utah, as endangered by emergency rule. The Mojave population was designated in the emergency rule as all tortoises occurring north and west of the Colorado River, in California, Nevada, Arizona, and Utah. The Mojave population was then proposed under normal listing procedures on October 13, 1989, and listed as threatened on April 2, 1990 (U.S. Fish and Wildlife Service 1994c).

The Mojave population of the desert tortoise occurs primarily on flats and bajadas characterized by scattered shrubs and abundant inter-space for growth of herbaceous plants, with soils ranging from sand to sandy-gravel. Desert tortoises are also found on rocky terrain and slopes, and there is significant geographic variation in the way desert tortoises use available resources. The Mojave population was listed because desert tortoise numbers are declining precipitously in many areas. These declines are mainly attributed to direct and indirect human-caused mortality coupled with the inadequacy of existing regulatory mechanisms to protect desert tortoises and their habitat. Impacts such as the destruction, degradation, and fragmentation of desert tortoise habitat result from urbanization, agricultural development, livestock grazing, mining, and roads. Human “predation” is also a major factor in the decline of desert tortoise populations. Predation is used here in its broadest sense, meaning the taking of desert tortoises out of their populations either by death (accidental or intentional) or removal from native habitat. An upper respiratory tract disease (URTD) is an additional major cause of desert tortoise mortality and population decline, particularly in the western Mojave Desert (U.S. Fish and Wildlife Service 1994a).

## SURVEYS FOR DESERT TORTOISE IN GRAND CANYON NATIONAL PARK

We are currently assembling survey information and will forward that information as it becomes available.

**CONSERVATION MEASURES FOR DESERT TORTOISE AND ITS HABITAT**

No conservation measures are necessary, as no wildland fire use activities or effects will be occurring in or near desert tortoise habitat.

**EFFECTS OF THE PROPOSED ACTION ON DESERT TORTOISE AND ITS HABITAT**

We are not currently including any type of desert scrub habitat in our wildland fire use program. Wildland fire use activities in other types of habitat do not have the potential to escape into or to otherwise affect the desert tortoise or its habitat. It is our conclusion that the wildland fire use program will have no effect on the desert tortoise.

**POTENTIAL FOR CUMULATIVE EFFECTS OF NON-FEDERAL ACTIONS TO DESERT TORTOISE OR ITS HABITAT.**

We are aware of no non-federal actions that would cause cumulative effects to the desert tortoise or its habitat.

# XIII. MEXICAN SPOTTED OWL

## BACKGROUND

The Mexican spotted owl (*Strix occidentalis lucida*) is one of three subspecies of spotted owl occurring in the United States; the other two are the northern spotted owl (*S. o. caurina*) and the California spotted owl (*S. o. occidentalis*). The Mexican spotted owl is distinguished from the California and northern subspecies chiefly by geographic distribution and plumage. The Mexican spotted owl is mottled in appearance with irregular white and brown spots on its abdomen, back, and head. The spots of the Mexican spotted owl are larger and more numerous than in the other two subspecies, giving it a lighter appearance (U.S. Fish and Wildlife Service 2001).

Mexican spotted owls (*S. o. lucida*), found on forested plateaus and canyonlands throughout the Southwest United States and Mexico, have been thought to be dependent on late seral forests (Ganey and Balda 1989a, Gutierrez et al. 1995). The Mexican spotted owl is generally restricted to isolated patches of habitat that include mixed conifer and pine-oak forests, riparian madrean woodland, and sandstone canyonlands (U.S. Fish and Wildlife Service 1995d). Zwank et al.(1994) reported that Mexican spotted owls were common in mature forests in New Mexico. Ganey and Balda (1989a, 1989b, and 1994) demonstrated that Mexican spotted owls were most common in mixed conifer and pine forests in Arizona south of the Grand Canyon, although they reported several sites where the owl was found breeding in rocky canyon habitat with scattered stands of forest vegetation.

Although typically associated with mature forest habitat, Rinkevich (1991) and Willey (1995) confirmed the presence of Mexican spotted owls within arid canyonlands scattered across southern Utah and northern Arizona. In these locations, the owl was associated with steep sandstone canyons that included relatively open Great Basin Desert scrub and Great Basin conifer woodland vegetation communities (Brown 1982). The canyonland breeding habitat has been described as “aberrant” considering the late seral forest habitat requirements reported for the owl in the literature (Gould 1977; Forsman et al. 1984; Zwank et al. 1994; Seamans and Gutierrez 1995; Miller et al. 1997). Rinkevich and Gutierrez (1996) and Willey (1995) found 21 spotted owl pairs associated with relatively dry and open canyon topography with small patches of forest vegetation in Zion National Park. Willey (1995) described the distribution of the owl in the Utah canyon country and suggested that the owl was not dependent on mature forest vegetation as previously believed (e.g., Gutierrez et al. 1995).

The Mexican spotted owl was listed as threatened on March 16$^{th}$, 1993, and the final rule designating critical habitat was published on February 1$^{st}$, 2001. Two primary reasons were cited for listing the owl as threatened. The first was historical alteration of habitat as the result of timber management

practices, specifically the use of even-aged silviculture, and the threat of these practices continuing. The second was the danger of catastrophic wildfire (U.S. Fish and Wildlife Service 2001).

**MEXICAN SPOTTED OWL SURVEYS AT GRAND CANYON NATIONAL PARK**

Mexican spotted owls have been reported in numerous visitor accounts for Grand Canyon National Park since the 1920s (unpublished park wildlife records, GCNP Natural Resources Office). Willey (1992) formally confirmed the presence of spotted owls within Grand Canyon National Park during field surveys conducted on the North and South Rims. These initial surveys encompassed approximately 6,000 acres of suitable habitat and used the formal U. S. Forest Service protocol in existence at the time (U.S. Department of Agriculture 1991). Willey's (1992) few responses were from within the canyon itself rather than the plateau areas. In 1994 and 1995, the most suitable South Rim plateau habitat was surveyed with negative results (Kuenzi, unpub., Kaibab National Forest Wildlife files).

In 1998 and 1999, a large-scale survey was undertaken on the North Rim (Willey 1998 and 1999). These surveys covered all suitable owl habitat on the heavily forested North Rim plateau area, including the Walhalla Plateau, and used the formal U.S. Fish and Wildlife Service survey protocol (U.S. Department of Interior 1995). No responses were elicited from owls during these surveys.

Additional surveys were conducted in 1999 by Willey in side canyon habitat with access achieved through the Colorado River corridor. These surveys located two pairs and four single male MSOs in side canyon habitat.

In 2001, a large-scale river-based inventory was undertaken with the result of approximately 30 additional side-canyon dwelling owls located (Willey and Ward 2001a). Surveys from the rim were also conducted along a 30-mile stretch of South Rim Plateau habitat, and in the Cape Royal and Point Imperial areas with several new territories being located (Willey and Ward 2001b). The Walhalla and Outlet Plateaus were also surveyed in 2001 with negative results. In 2002, a pair of owls was located near the Bright Angel peninsula. See the MSO Protected Activity Center (PAC) map in Appendix H for more information on provisional PACs.

Taken together, the owl locations in the park suggest that the owl occupies the rugged canyonland terrain within the Grand Canyon rather than more classical late seral forest habitats on the North and South Rims.

Given the large extent of potential canyonland habitat, a relatively large, and virtually unknown, spotted owl subpopulation may exist in Grand Canyon National Park. The status and management of these owls is therefore highly relevant to the species overall conservation and demographic health. This

population may represent a potentially large source population for the Southwest as a whole (Shaffer 1985).

**CONSERVATION MEASURES FOR THE MEXICAN SPOTTED OWL**

The following conservation measures have been adopted as part of the project description, and will be adhered to during project operations, **unless such adherence compromises safety**.

- Park wildlife biologists will be consulted early in the decision-making process for wildland fire use fires.
- To minimize negative effects on habitat, wildland fire use fires will be managed as low-intensity fires, as discussed in the project description. Our objective will be to limit mortality of trees greater than 18" DBH to less than 5% across the project area. While natural fire starts will not be allowed to burn if fire managers anticipate mortality greater than 5% in large trees ($\geq$ 18" DBH), we recognize that occasionally up to 10% mortality may occur in large trees because fire is not a precision tool.
- The park will adhere to the air quality standards set by the Arizona Department of Environmental Quality.
- If fireline construction is necessary, we will minimize the cutting of trees and snags larger than 18" DBH, and no trees or snags larger than 24" DBH will be cut unless absolutely necessary for safety reasons. Mortality of trees greater than 24" DBH will be
- If fireline construction is necessary, we will rehabilitate the line after use. This will be done by pulling soil, duff, litter, woody debris, and rocks back onto the line to bring it up to grade and to make it blend in with the surrounding area.
- If new fire-related activity centers, such as dip sites or drop points, are necessary, these will be located at least 400 meters from the boundary of any designated Protected Activity Center.
- To the maximum extent possible, aircraft will remain at least 400 meters from the boundary of any designated Protected Activity Center.
- If Mexican spotted owls are discovered during project activities, a park wildlife biologist will be notified immediately.
- Firefighters will not approach or haze Mexican spotted owls, if found.
- We will survey known PACs that can be surveyed from the rim, and that are adjacent to potential wildland fire use areas as described in this document.
- We will consider limiting the movement of fire over the rim and into PACs on a case-by-case basis, through consultation between resource managers and fire managers.
- We will adhere to the recommendations set out in the USFWS memo, "*Clarification of Recommendations in the Recovery Plan for*

*the Mexican Spotted Owl in Regards to Prescribed Natural Fire"*, dated 2 September 1997, which is included as Appendix I.

**EFFECTS OF THE PROPOSED ACTION ON THE MEXICAN SPOTTED OWL**

Although we will be surveying many acres of habitat on the rim annually, we do not have the resources to survey all potential habitat or all potential wildland fire use areas. For that reason, we may conduct wildland fire use fires in unsurveyed habitat. We will rely on our conservation measures to minimize the possibility of harm to any owls that might be present.

During project activities, possibilities exist for direct injury or disturbance to owls from fire, smoke, increased levels of noise and activity, aerial application of water or retardant, and collision with aircraft. Indirect harm could occur through damage to habitat. Each of these factors is discussed below, as are the conservation measures that are intended to minimize the possibility of harm.

***Fire***

As previously discussed, wildland fire use fires are largely low intensity ground fires, with occasional patches of moderate and high intensity fire. In three recent fires of this type in the park, our burn severity analysis indicated that the areas of high or moderate-to-high burn severity totaled only 4 to 18% of the total area within the fire perimeter.

Lehman and Allendorf (1989) and Smith (2000) note the low fire-caused wildlife mortality figures from several studies and conclude that low intensity wildfires usually do not kill animals, as most are able to hide or escape. Young animals with limited mobility would obviously be at greater risk, including young spotted owls.

Although there is certainly some risk of directly harming owls through wildland fire use, we feel that the overall probability of this happening is relatively low, even for young owls. Our survey data suggest a low probability of finding nesting owls above the rim on either rim, and a low probability of finding any owls above the rim on the north rim, where most of our wildland fire use activity would take place. This indicates a relatively low potential for overlap of wildland fire use activities and occupied owl habitat, but some overlap will occur if fire moves over the rim into PACs. As a conservation measure to address this, we will consider limiting the movement of fire into known PACs on a case-by-case basis, taking into account probable fire behavior in the PAC, timing within the breeding season, and survey results for the PAC.

***Noise and visual disturbance***

The activities associated with managing a wildland fire use fire are usually very minimal, involving only monitoring of the fire's progress. As previously described, small numbers of fire monitors will walk and drive in and around the fire perimeter on a regular basis.

In some cases, it also becomes necessary to use suppression techniques to manage the fire. These can range from small efforts such as putting in a fireline around a cultural resource site to suppressing one flank of a fire while allowing the other to grow. It is also possible that the fire could exceed the prescription and cease to be a low intensity ground fire, or could threaten the pre-established MMA boundaries, in which case, full scale suppression activities will be undertaken. These activities would result in increased levels of disturbance from personnel on the ground and from aircraft.

The presence of firefighters in occupied Mexican spotted owl habitat could induce behavioral changes in both juveniles and adults, but the extent of this impact is largely unknown. No study directly analyzes suppression activities, but Swarthout and Steidl (2001) examined the effects of backcountry recreation on Mexican spotted owls in Utah. They observed that, with the approach of a hiker, juveniles and adults were unlikely to flush at distances >12m and >24m, respectively, and neither age-class was likely to alter their response at all when hikers were at distances >55m. The presence of small fire crews rather than a single hiker would no doubt increase flush response, but to what degree is unknown. Aside from flush response, Swarthout and Steidl (2001) examined other behavioral traits and noted that activity budgets did not change markedly when hikers passed near nests every 15 minutes. During the disturbance periods, females decreased the amount of time they handled prey by 57% and increased contact vocalizations by 58%, but were otherwise unaffected.

Relatively few studies have been made on the response of animals to noise and visual stimuli produced by aircraft. These studies have been supplemented with incidental observations, but there still remains a dearth of information on the subject. Reported animal responses vary greatly among species, and the ability of species to adapt to overflights also varies. In general, the long-term effects of aircraft overflights are unclear. The potential consequences from noise are thought to be greatest on breeding animals (National Park Service 1994). The majority of studies on wildlife responses to overflights suggest that responses appear to be temporary and do not result in long-term effects to animal population numbers or habitat use. However, few of these studies provide empirical data on long-term impacts of chronic noise exposure. The few studies available that evaluate measures of reproductive success (e.g., return to nest sites, fledgling body weights and number of young raised) were conducted over only a one or two year period. Therefore, the long-term effects of very frequent overflights need to be studied on this and other raptor species before definitive conclusions can be formulated.

Animal responses reported in the literature have been either physiological or behavioral in nature (Knight and Gutzweiller 1995). Physiological effects may include temporary or permanent hearing threshold shifts, masking of auditory signals, increased respiration and heart rate, and increased corticosteroid levels. Reported hearing threshold shifts were related to noise sources that were of much greater duration (minutes and hours) than a typical aircraft overflight in Grand Canyon, which generally lasts from a few seconds to a minute. Behavioral responses may include animals becoming alert and turning toward the sound source, running from the sound source, changes in activity patterns (e.g., interrupted feeding), nest abandonment, or changes in habitat use. If the changes are sufficiently severe, the health and survival of an individual animal may be reduced. If a large number of animals are affected, then population declines could result.

A limited number of studies have evaluated the effects of human-induced disturbance and noise on raptors. Predictably, raptor responses to noise and disturbance in these studies have varied. Most studies reported relatively minor impacts and many of these found effects to be temporary (e.g., Lamp, 1987). In the few cases where reproductive success was evaluated, reproductive parameters were sometimes affected, but not to a large degree. The studies discussed below evaluated noise sources from ground-based activities as well as aircraft. Frazer et al. (1985) and Grubb and King (1991) reported that nesting raptors were more sensitive to ground-based activities compared to aircraft. Grubb and King (1991) also reported that animals show a greater response to helicopters than to fixed-wing aircraft. In certain studies discussed below, the general findings of research on ground-based noise are also provided to further show the general responses of raptors to noise.

Grubb and King (1991) evaluated nesting bald eagles and reported that eagles reacted more strongly to pedestrians and helicopters than to fixed-wing military jet aircraft. Eagles responded to aircraft 75% of the time when overflights were about 300 feet from the nests. They suggested that the severity of response was related to a variety of factors including distance (most important), duration, visibility, number, position, and noise level. They did note that response to aircraft did not linearly increase as distance decreased. Frazer et al. (1985) evaluated responses of bald eagles in Minnesota to overflights. Based on over 850 overflights of fixed-wing aircraft, only two eagles flushed from nests, but 10% of birds flushed from perches.

Holthuijzen et al. (1990) studied the response of four nesting pairs of prairie falcons to construction blasting and four nesting pairs to experimental blasting in southwest Idaho. They reported that incubating and brooding falcons flushed about 22% of the time but on average returned to the nest within 3.4 minutes and resumed activities within an additional 2.5 minutes. Two of the four pairs exposed to construction blasting fledged young, while all four pairs exposed to experimental blasting fledged young. Three of four nests in the construction blasting area were not reoccupied the following

year, whereas all nests were reoccupied in the experimental blasting area. The authors suggested that activities not be conducted closer than about 140 feet when peak noise levels were 140 dB or less. In addition, they suggested that no more than three blasts a day occur.

Anderson et al. (1990) evaluated the responses of red-tailed hawks, Swainson's hawks, ferruginous hawks, and golden eagles to ground-based military training activities occurring in August in southeastern Colorado. The authors reported that home range size generally increased during military training. They also noted that one of two ferruginous hawks and the Swainson's hawk left the area and did not return until the following spring. The authors speculated that the changes in home range may increase energy needed by the birds and reduce reproductive success if training occurs during the nesting season.

A few studies have evaluated raptor responses to helicopters. Ritchie (1987) reported that peregrine falcon responses varied from no response to flushing when helicopters were within 2,000 feet of the birds. Craig and Craig (1984) reported that prairie falcons, red-tailed hawks, and golden eagles exhibited varied responses when helicopters passed nearby. Individual bird responses ranged from absolutely no response to abandonment of perches as helicopters approached. In a study of red-tailed hawk response to helicopters, Anderson et al. (1989) reported that birds would flush from their nests but that the overflights did not appear to affect rearing of young. White and Sherrod (1973) reported that nesting raptors flushed from nests when overflown by helicopters that approached unseen. These authors, as well as others, suggest that raptors may be more likely to flush if the noise or sight of the aircraft is sudden and in close range to the nests. Marzluff et al. (1994) concluded that Army National Guard training within the Snake River Birds of Prey National Conservation Area was correlated with increased foraging distances and temporary training area avoidance in prairie falcons. It is probable that increases in foraging distances may result in stress to birds by increasing the energetic costs of foraging.

Contrary to the somewhat negative reports described above, other researchers have concluded that exposure to fixed-wing aircraft did not negatively affect raptor species. White and Thurow (1985) reported that ferruginous hawks did not respond to fixed-wing aircraft within 100 feet of their nests. Most authors, however, note that their studies deal with low frequency overflights and caution that frequent low altitude flights could reduce nesting success.

In a study involving peregrine falcons and military aircraft (Ellis 1981), birds were observed during more than 1,000 overflights with noise levels of 82 to 114 A-weighted decibels (dBA). Responses usually included abandoning current behavior and watching the aircraft, but alarm behavior occurred when aircraft were between 500 feet (nearest reported distance) and 1,600 feet above ground level. Birds did not respond appreciably to aircraft beyond

1,640 feet. When responses did occur with aircraft passing at closer distances, the responses were temporary and did not result in reproductive failures. Ellis also collected limited physiological data on prairie falcons, concluding that elevated heart rates caused by aircraft overflights were temporary and within the normal response parameters of this species.

In a follow-up study, Ellis et al. (1991) evaluated the effects of low-level military aircraft flights on 18 peregrine falcon nest sites and nearly 40 breeding attempts of several other raptor species, including prairie falcons. Response of raptors was observed for more than 1,000 overflights that ranged from 220 feet to 1,500 feet from nests and generally resulted in Sound Exposure Levels (SEL) greater than 90 dBA (SEL is a single event composite measure that takes into account the maximum noise level associated with a noise event and the duration of the event). Of the 1,000-plus flights, 482 were within 500 feet of nests. Of the 482 passes within 500 feet, 52 (4%) resulted in cowering or flight responses. The remaining 430 flights (96%) resulted in birds temporarily stopping activities, orientating and observing the aircraft, or exhibiting no response. In addition, the authors noted that all responses to aircraft were temporary and minor. Fledgling success for all raptor nests observed was 89% (34 of 38 nests) and peregrine falcon fledgling success was similar to general state trends. Similarly, 21 of the 22 peregrine falcon nests used for observations during the study were occupied the following year, with 19 positively identified as active nests. The authors did state that extrapolation of the results estimating long- term productivity impacts was not feasible.

Enderson and Craig (1994a & 1994b) and Enderson (1996) evaluated the effects of aircraft overflight on peregrine falcons near Colorado Springs and the Fort Carson Airburst Gunnery Range. Five adult birds were fitted with telemetry and movements were monitored in 1994. Observational information was generated regarding movements (Enderson and Craig 1994b) and response to overflights. Home ranges averaged about 350 square miles and overlapped. Adults hunted up to 32 miles from nest sites (Enderson 1996). Enderson concluded that military operations did not affect the ordinary outcomes of nesting behavior. He speculated that this was due to the fact that peregrines normally live in very noisy environments where they were stimulated on a daily basis by thunderstorm activity near their nest sites.

Studies that specifically address effects of aircraft noise and visual stimuli on Mexican spotted owls are limited. Delaney et al. (1999) studied the effects of helicopter noise and chain saws on Mexican spotted owls in the Lincoln National Forest. They compared noise stimulated plots and control plots and found that “manipulated and non-manipulated nest sites did not differ in reproductive success (P = 0.59) or the number of young fledged (P = 0.12).” They recommend 105-m buffer zones around nest sites for helicopter overflights. Johnson and Reynolds (2002) studied the responses of Mexican spotted owls to low-flying military jet aircraft. In several trials, they found

that the owls' responses to the overflights ranged from no response (no body movements) to an intermediate response (sudden turning of the head). These responses did not exceed the range of behaviors exhibited before and after the overflights.

The Mexican spotted owl's seemingly preferred habitat of steep canyons below the rim in Grand Canyon suggest that aircraft overflights will often be obscured from owls, but that the high canyon walls may also amplify the stimuli and repeat it through echoes. Given that aircraft pass over the rims of Grand Canyon at low elevations, the potential does exist for disturbance to owls, especially if they are using the upper reaches of side canyons, or if they are using the mixed-conifer habitat above the rim. As a conservation measure to minimize the potential for disturbance, aircraft involved in fire management activities will not approach within 400 meters of PAC perimeters unless safety considerations over-ride this restriction. Some potential also exists for other wildland fire use project-related activities to disturb owls. As an additional conservation measure to minimize this potential, no new project-related activity centers will be established within 400 meters of PAC boundaries. We expect that these measures should minimize disturbance to owls from wildland fire use activities.

### *Collisions with Aircraft*

Bird strikes occur with significantly greater frequency than is generally imagined. Conover et al. (1995) compiled reported statistics and estimated that annual losses in the United States totaled $200 million to civilian aircraft, $45 million to military aircraft, and seven fatalities. Bird strike data are difficult to accumulate and analyze given the fact the only sources of these data are voluntary pilot reports (FAA form 5200-7). It has been estimated that only 20 to 30% of all bird strikes are reported by pilots (Burger 1985; Conover et al. 1995). Collisions between owls and aircraft have been documented for a variety of species (Krivitski 1991; Linnell et al. 1996; Garber 1998). Linnell et al. (1996) determined that of the 526 bird strikes that occurred between 1990 and 1994 at Lihue (Hawaii) Airport, 43 (8.2 %) involved barn owls (*Tyto alba*) and 23 or 4.4% involved short-ear owls (*Asio flammeus*).

No data are available documenting the number of collisions between birds and aircraft that occur over Grand Canyon National Park or at Grand Canyon Airport. Given the extremely low population number of Mexican spotted owls in the area and the fact that overflights occur during the day when owls are least active, the possibility is decidedly remote that a collision will occur.

### *Smoke*

The park is a Mandatory Federal Class I area for air quality under the Clean Air Act, making the park, and fire management, subject to stringent air quality standards set by the Arizona Department of Environmental Quality

(ADEQ). Amounts of smoke which would be associated with a violation of the ADEQ standards would also be likely to pose risks for visitors, and by extension, to wildlife. Because such a violation would be a serious problem for the park, every effort is made to avoid this during any prescribed fire or wildland fire use operation. First, such operations are only conducted when weather forecasts and current conditions indicate that smoke will be carried up and away from the canyon on the prevailing southwest winds. Second, various methods of air quality monitoring (dataRAM particulate monitors, transmissometers, photo points) are employed at several locations in Grand Canyon during such operations. The data collected is analyzed on a continuous basis and the results are passed on to fire managers and to ADEQ. If an impending violation is detected, fire managers will adjust management strategies to reduce smoke production and avoid the violation. These measures will limit the potential for negative effects to the owl from smoke.

There is a lack of scientific literature detailing what effects smoke may have on the Mexican spotted owl or other raptor species. Given that Mexican spotted owls have co-evolved with fire-adapted ecosystems in the southwest, they are no doubt tolerant of a certain amount of smoke, but no data are available to determine what this level of tolerance might be. As with other fire effects, young, less mobile owls would be more likely to be negatively affected than adults which could more easily move away from smoke. Again, the timing of most wildland fire use fire in late summer will help to minimize the possibility of greater effects on young owls.

Until we have more information on how smoke affects owls, we will have to rely on the park's adherence to the ADEQ air quality standards to minimize any negative effects. While the possibility certainly exists for some effect to owls, it is reasonable to expect that the ADEQ standards will serve to protect owls from extensive exposure to heavy smoke.

### *Damage to habitat*

The Mexican spotted owl Recovery Plan is supportive of the use of fire as a treatment to reduce the risk of catastrophic wildfire in owl habitat. The plan acknowledges that:

> *The risk of catastrophic fires is widespread in Southwestern forests and woodlands. Fuel accumulations and forests overstocked with trees place spotted owl habitat at risk with respect to stand-replacing fires.* (U.S. Fish and Wildlife Service 1995d, p. 60)

It also states that:

> *Given the present conditions of Southwestern forests, extreme fire years could result in holocaustic fires throughout large portions of the owl's range. Because the resulting damage to owl habitat would be*

> *irreparable in the foreseeable future, efforts to limit large-scale catastrophic fires are of the utmost importance for owl conservation.*
>
> *Increased use of fire and other tools will be needed to reduce the amount of forest at high risk from stand-replacing fires. The Recovery Team encourages proactive fire management programs which assume active roles in fuels management and understanding the ecological role of fire.* (U.S. Fish and Wildlife Service 1995d, p. 61)

The Recovery Plan divides Mexican spotted owl habitat into protected habitat, restricted habitat, and other forest and woodland habitat. Protected habitat includes the 600 acre (243 ha) Protected Activity Centers [PACs] which are designated around known nest or roost sites. It also includes >40% slopes in mixed-conifer or pine-oak habitat which have not been harvested in the last 20 years. Protected habitat areas receive the highest level of protection, and the Recovery Plan offers very specific guidelines for the management of these areas. Restricted habitat areas include pine-oak, mixed-conifer, and riparian forests, and these areas receive the next highest level of protection. The Recovery Plan presents target/threshold guidelines for development or maintenance of nesting and roosting habitat within these areas. Other forest and woodland habitat areas include pure ponderosa pine forest, spruce-fir forest, aspen groves, and pinyon-juniper woodland. These areas receive the least protection and no specific guidelines are offered for management of these areas.

*Protected Areas – Protected Activity Centers*

The park currently contains 38 PACs or provisional PACs, encompassing 29,437 acres. The largest portion of these PACs falls below the rim, in a combination of canyon and forested canyon habitat.

According to the park's fire history records, fire has overlapped the areas currently designated as PACs only 6 times and has affected only 53 acres total. The fire history map in Appendix J can be compared with the PAC map in Appendix H to illustrate this. The records also show that very little fire has dropped over the rim outside of PACs, suggesting the limited overlap of fire and PACs is not simply a result of owls avoiding the burned areas.

While wildland fire use projects are not targeted at areas below the rim, it is desirable to draw the project boundaries (Maximum Manageable Areas or MMAs) to include areas over the rim and down to approximately the Coconino sandstone layer, where a natural firebreak commonly occurs. Setting the boundary of a wildland fire use fire at the rim creates an artificial, and much less defensible, boundary. Holding a fire at the rim often requires extensive use of a helicopter to drop water. This is a problem, as it is a hazardous operation which greatly increases the overall risk associated with the project. Such operations will also cause additional disturbance to wildlife in the area.

Although it is undesirable to set the MMA at the rim for an entire wildland fire use project, it is possible to limit a fire's movement over the rim in key areas, such as PACs. This is the approach we propose to take. The decision to keep fire from moving into specific areas will be made on a case-by-case basis through consultation between resource and fire managers. By considering the individual conditions involved with each fire and each PAC, we expect to increase safety, minimize disturbance, and limit the potential for damage to habitat within PACs.

*Protected Areas – Mixed-Conifer Steep Slopes*

The park contains approximately 10,430 acres of mixed-conifer steep slope protected habitat outside of PACs. Most of these other protected areas occur in canyon habitat below the rim, with a limited amount occurring above the rim. The Mexican spotted owl Recovery Plan states (U.S. Fish and Wildlife Service 1995d, p. 89) that prescribed natural fire (now called wildland fire use) is permitted in these areas, with no seasonal restrictions, and it stresses the importance of treating these areas to reduce the risk of catastrophic fire in steep slope habitat.

On steep slopes, fuel arrangement and topography often combine to produce higher fire severity than on level ground. Because of this, the threat of total habitat loss from high intensity wildfire is greater in this steep slope habitat. For the same reasons, the potential for damage to steep slope habitat from wildland fire use is also greater. However, during a wildland fire use operation, fire managers are likely to have more opportunities to manipulate the fire to get desirable results. Again, consultation between resource and fire managers will be used to identify the need to take additional action to protect these areas. We expect that the protective benefits of treating steep slope habitat through wildland fire use will far outweigh any potential negative effects.

*Restricted Areas*

The park contains approximately 64,922 acres of restricted Mexican spotted owl habitat. As the portion of the Colorado Plateau Recovery Unit in which the park falls does not, by definition, contain the pine-oak type of restricted habitat, all restricted habitat in the park is either mixed-conifer or riparian habitat. No areas meeting the definition of restricted riparian (broad-leaved forest) habitat will be included in wildland fire use projects, and there is no potential for damage to this habitat type from wildland fire use activities. The mixed-conifer restricted habitat (ponderosa forest with >5% Douglas-fir, white fir, and/or blue spruce, and <5% corkbark fir, subalpine fir, and/or Engelmann spruce) makes up the largest part of the restricted habitat in the park, and will be included in wildland fire use project areas.

The key habitat components which make mixed-conifer restricted habitat important to owls include hardwoods, a multi-storied canopy, high tree basal

area, high canopy cover, large down logs, large trees, and snags. All of these components are also primary constituent elements of critical habitat for Mexican spotted owls. Because all of the protected and restricted habitat in the park is also critical habitat, we will avoid repetition by discussing the specific effects of wildland fire use on these habitat components in the Mexican spotted owl critical habitat section which follows.

The Recovery Plan provides target/threshold conditions (U.S. Fish and Wildlife Service 1995d, Table III.B.1, p. 92) as guidelines for maintenance and development of the key habitat components in appropriate amounts across the landscape. The plan states:

> *We used tree basal area, large tree (>45.7cm[18in] dbh) density, and tree size-class distribution as the variables to define target/threshold conditions (Table III.B.1). Other variables such as snags and downed logs are important as well. We assume that if the basal area and tree density levels given in Table III.B.1 exist, adequate amounts of snags and downed logs (and other habitat elements) should be present.* (U.S. Fish and Wildlife Service 1995d, p. 91)

As these target/threshold conditions are not discussed specifically in the critical habitat designation, we will deal with those in this section. The target/threshold conditions for mixed-conifer in the Colorado Plateau recovery unit are as follows:

- In 25% of the planning area, 10% of the stand density of trees should occur in each of the 12-18" DBH (diameter at breast height), 18-24" DBH, and 24"+ DBH size classes.
- In 25% of the planning area, total tree basal area should be 32 $m^2$/hectare (150 $ft^2$/acre), and density of trees >18" DBH should be 49 trees/hectare (20 trees/acre).
- In a subset of the 25% portion of the planning area, 10% of the planning area should have the same stand density distribution as described above, should have a total tree basal area of 39 $m^2$/hectare (170 $ft^2$/acre), and should also have a density of trees >18" DBH of 49 trees/hectare (20 trees/acre).

The park's fire effects monitoring program, although not designed to provide data to address the target/threshold conditions, can provide information on the nature of mixed-conifer habitat in the park. The program has also recently had the opportunity to collect data on stand conditions before and after a wildland fire use fire in mixed-conifer habitat. This fire effects data was also supplemented with remotely-sensed and ground-truthed burn severity data. Although we have a relatively small sample, these data provide some idea of what effects we can expect from wildland fire use fires relative to target/threshold conditions.

Mixed-conifer is one of the vegetation types that the fire effects monitoring program uses to stratify plots. We define the type as follows:

> *PHYSICAL DESCRIPTION*
> *Located at 8000 to 9000 feet elevation on the North Rim with slopes from 0% to 60%, including all aspects. Soils are moderately shallow on ridgetops with silty loams occurring in drainage bottoms. All soils are derived from Kaibab limestone parent material.*
>
> *BIOLOGICAL DESCRIPTION*
> *Total canopy cover is at least 25% but can near 100%. It is a mixed conifer forest dominated by Pinus ponderosa, Abies concolor, and Populus tremuloides with the greatest basal area in Pinus ponderosa even though there may be more overstory Abies concolor stems per acre. Other possible overstory species include Pseudotsuga menziesii, Picea pungens, Abies lasiocarpa, and Picea engelmanni. The understory is composed of mostly Abies concolor (25 to 100%), Pinus ponderosa, Populus tremuloides, and Pseudotsuga menziesii. Common brush species are Amelanchier utahensis, Berberis repens, and Robinia neomexicana. Common herbaceous plants include Bouteloua gracilis, Carex spp., Fragaria ovalis, Lotus utahensis, Pedicularis centranthera, and Poa fendleriana.*
>
> *REJECTION CRITERIA*
> *Large rock outcroppings or barren areas >20% of the plot; areas with anomalous vegetation, boundary fences; areas within 30 meters of roads, utility corridors, human-created trails, human-created clearings, or slash piles; areas within 10 meters of significant historic or prehistoric sites or transitional ecotones; areas burned in the last 10 years; areas where majority of basal area is not in ponderosa pine; areas with pole densities that do not include white fir as a major component.* (National Park Service 2000)

There are currently 24 plots installed in this vegetation type, randomized across several North Rim prescribed fire units. Seven of these plots burned in low-intensity portions of the Vista Fire in 2001, which began as a wildland fire use fire, and was later converted to a wildfire.

The pre-treatment measurements from the 24 mixed-conifer plots can give us an indication of what initial pre-burn conditions exist across the vegetation type. We cannot directly address what conditions might be present within subsets of the total area, e.g., the 25% and 10% areas discussed in Table III.B.1.

In the pre-burn measurements on these plots, the 12-18”, 18-24”, and 24”+ size classes contained 16%, 14%, and 25% of the total stand density index, respectively. This exceeded the desired goal of 10% for each class. Total tree basal area, including all trees >1” DBH, was 219.2 $ft^2$/acre, while

density of trees >18" DBH was 30.5 trees/acre. These measurements also exceeded the target/threshold values given in the Recovery Plan, indicating that pre-treatment conditions across the mixed-conifer vegetation type adequately meet the guidelines.

The pre- and post-burn measurements from the seven plots burned in the Vista fire can give us an indication of the effects of a low-intensity wildland fire use fire in mixed-conifer. The post-burn measurements were collected immediately post-burn, in the summer of 2001. It is important to note that seven plots is not a large sample size relative to the type of data collected, and the results from this set of plots are not definitive.

In these seven plots, the percent of stand density index represented by the 12-18" size class changed from 19% pre-burn to 20% post-burn. The 18-24" size class changed from 9% of the total stand density index pre-burn to 10% of the total stand density index post-burn. The 24"+ size class changed similarly, from 22% pre-burn, to 23% post-burn. All of the post-burn figures meet or exceed the desired value of 10% for each size class on 25% of the total planning area.

The total tree basal area on these plots, including all trees >1" DBH, decreased from 255.0 $ft^2$/acre pre-burn to 245.1 $ft^2$/acre post-burn. This still exceeds the 150 $ft^2$/acre desired on 25% of the planning area, as well as the 170 $ft^2$/acre desired on 10% of the planning area. The density of trees >18" DBH remained unchanged at 27.7 trees/acre, exceeding the desired goal of 20 trees/acre. The density of trees in the 1-6" size class decreased from 878.8 trees/acre and a stand density index of 120 pre-burn, to 691.4 trees/acre and a stand density index of 101 post-burn. This suggests that the fire successfully removed a portion of the small understory trees.

In addition to recognizing that low-intensity fire achieved target/threshold conditions where it occurred, it is also important to consider what proportion of a fire burned at a low intensity. We have recently been able to address this issue through an analysis of burn severity using satellite imagery.

This analysis indicated that 64% of the area within the perimeter of the Vista fire burned at a low intensity, or remained unburned. An additional 18% burned at moderate-to-low intensity and the remaining 18% burned at moderate-to-high or high intensity. It is also important to note that the Vista Fire was reclassified as a wildfire when it had reached less than half of its final size. In two additional wildland fire use fires, the Swamp Ridge and Tower fires, the low severity and unburned areas made up 80.9% and 84.2% of the total areas, respectively. These figures suggest that wildland fire use fires will, in general, will achieve target/threshold conditions by producing low intensity burns in an appropriate proportion of the project area.

See the Mexican Spotted Owl Critical Habitat section which follows for additional discussion of the effects of wildland fire use on specific habitat components.

OTHER FOREST AND WOODLAND TYPES

The Recovery Plan offers no specific guidelines for other forest and woodland types outside of protected and restricted habitat. It states, however, that these types may still be important for the owl as habitat for activities other than nesting and roosting, and offers the following:

> *Guidelines developed for protected and restricted areas may have useful applications when judiciously administered in these other forest and woodland types. Such guidelines include managing for landscape diversity, mimicking natural disturbance patterns, incorporating natural variation in stand conditions, retaining special features such as snags and large trees, and utilizing fires as appropriate. We also emphasize the need for proactive fuels management where appropriate. Decreasing fire risks within these types, particularly ponderosa pine forests, will also decrease fire risks to adjoining protected and restricted areas by minimizing the probability of large landscape-level crown fires that could impinge upon occupied or potential nesting habitat.* (U.S. Fish and Wildlife Service 1995d, p 96)

We also have fire effects monitoring data from 11 plots which burned in the Tower fire, a wildland fire use fire which occurred in our ponderosa forest vegetation type in 2001.

In these 11 plots, the percent of stand density index represented by the 12-18" size class changed from 16% pre-burn to 17% post-burn. The 18-24" size class remained unchanged at 26% of the total stand density index, and the 24"+ size class remained unchanged at 40% of the total stand density index. All of the post-burn figures meet or exceed the desired value of 10% for each size class on 25% of the total planning area.

The total tree basal area on these plots, including all trees >1" DBH, decreased from 186.2 $ft^2$/acre pre-burn to 183.5 $ft^2$/acre post-burn. This still exceeds the 150 $ft^2$/acre desired on 25% of the planning area, as well as the 170 $ft^2$/acre desired on 10% of the planning area. The density of trees >18" DBH decreased from 40.8 trees/acre to 40.1 trees/acre, still twice the desired goal of 20 trees/acre.

All 11 plots underwent a low intensity burn, and 96.2% of the total area of the fire burned at low intensity or remained unburned. Although 11 plots is not a large sample size, these results suggest that target/threshold conditions exist in the ponderosa forest type as well, and that they can be maintained through wildland fire use.

### *Effects determination*

Taking all of these factors into consideration, it is our conclusion that the activities and results associated with the wildland fire use program may adversely affect the Mexican spotted owl through disturbance from activity, noise, or smoke. We also conclude that the Mexican spotted owl may, at the same time, benefit from the development, maintenance, and protection of target/threshold conditions in its habitat. We believe that the potential short-term negative effects associated with the wildland fire use program may be outweighed by the total of the long-term beneficial effects to owl habitat.

#### POTENTIAL FOR CUMULATIVE EFFECTS OF NON-FEDERAL ACTIONS TO MEXICAN SPOTTED OWLS

We are aware of no other non-federal activities occurring in or around the project area which would cause cumulative effects, adverse or otherwise, to the Mexican spotted owl.

# XIV. MEXICAN SPOTTED OWL CRITICAL HABITAT

## BACKGROUND

The final rule designating critical habitat for the Mexican spotted owl became effective on March 5th, 2001. Critical habitat units were designated in New Mexico, Arizona, Utah, and Colorado. Within the designated boundaries, all protected or restricted habitat as described in the Recovery Plan is considered critical habitat.

All critical habitat designations must consider the physical and biological features of habitat that are essential to the conservation of the species. These are called the primary constituent elements of the critical habitat, and for the Mexican spotted owl, include those features that support nesting, roosting, and foraging. Because the owls are found in both canyon and forest habitat, primary constituent elements were defined for each type of habitat. These are as follows:

### *Forest habitat*

- high basal area of large diameter trees
- moderate to high canopy closure
- wide range of tree sizes suggestive of uneven-age stands
- multi-layered canopy with large overstory trees of various species
- high snag basal area
- high volumes of fallen trees and other woody debris
- high plant species richness, including hardwoods
- adequate levels of residual plant cover to maintain fruits, seeds, and regeneration to provide for the needs of Mexican spotted owl prey species

### *Canyon habitat*

- cooler and often more humid conditions than the surrounding area
- clumps or stringers of trees and/or canyon wall containing crevices, ledges, or caves
- high percent of ground litter and woody debris
- riparian or woody vegetation (although not at all sites)

## MEXICAN SPOTTED OWL CRITICAL HABITAT AT GRAND CANYON NATIONAL PARK

### *Forest habitat*

The park currently contains over 75,000 acres of mixed-conifer protected and restricted critical habitat. The Outlet wildfire in 2000 burned slightly over 6100 acres of this habitat; over half of that burned at high or moderate-to-high intensity. The Vista and Tower fires in 2001 burned slightly more than 6300 acres of critical habitat; the percentage of high or moderate-to-high burn severity in those fire ranged from only 3.8% to 18.1%.

As discussed in the previous section, mixed-conifer habitat in the park appears to meet the target/threshold conditions outlined in the Recovery Plan. We will discuss the specifics of the primary constituent elements below, in the effects section.

### *Canyon habitat*

Over 29,000 additional acres of designated PACs are also critical habitat and are largely canyon habitat. Other critical canyon habitat is not quantified.

#### CONSERVATION MEASURES FOR MEXICAN SPOTTED OWL CRITICAL HABITAT

The following conservation measures have been adopted as part of the project description, and will be adhered to during project operations, **unless such adherence compromises safety**.

- Park wildlife biologists will be consulted early in the decision-making process for wildland fire use fires.
- To minimize negative effects on the primary constituent elements of critical habitat, wildland fire use fires will be managed as low-intensity fires, as discussed in the project description.
- If fireline construction is necessary, we will minimize the cutting of trees and snags larger than 18" DBH, and no trees or snags larger than 24" DBH will be cut unless absolutely necessary for safety reasons.
- If fireline construction is necessary, we will rehabilitate the line after use. This will be done by pulling soil, duff, litter, woody debris, and rocks back onto the line to bring it up to grade and to make it blend in with the surrounding area.

#### EFFECTS OF THE PROPOSED ACTION ON MEXICAN SPOTTED OWL CRITICAL HABITAT

### *Forest habitat*

As we did for the Mexican spotted owl target/threshold habitat conditions, we can use the 7 fire effects monitoring plots which burned in the Vista Fire to illustrate the effects of a low-intensity wildland fire use fire on the primary constituent elements of critical habitat.

*High basal area of large diameter trees*

On the 7 Vista plots, basal area of trees larger than 18" DBH remained unchanged at 110 $ft^2$/acre pre-burn to post-burn.

All 7 plots burned at low intensity, as did 64% of the total area of the fire, as shown by our analysis of burn severity. Even assuming that all the large diameter trees were lost in the areas that burned at moderate-to-high or

high intensity, which we know was not the case, we would still have an average of 70.4 $ft^2$/acre for the total acreage of the fire.

*Moderate to high canopy closure*

Our fire effects data does not address canopy closure directly. Results from the Vista plots suggest that canopy closure may be reduced through removal of small trees, but that the larger trees will remain. We expect that these will provide at least moderate canopy closure.

*Wide range of tree sizes suggestive of uneven-age stands*

In the post-burn measurements of the Vista plots, the percent of the total stand density index represented by the 0-6", 6-12", 12-18", 18-24", and 24"+ DBH size classes were 24%, 23%, 20%,10%, and 23%, respectively. This distribution suggests an uneven-age stand.

*Multi-layered canopy with large overstory trees of various species*

The wide range of tree sizes present on the Vista plots suggests that the canopy will also be multi-layered; this is confirmed by field observation. Various species are also present, with the trees larger than 18" DBH remaining post-burn including ponderosa pine (17.9 trees/acre), white fir (8.7 trees/acre), and douglas-fir (1.2 trees/acre).

*High snag basal area*

On the 7 Vista plots, basal area of snags 18" DBH and larger changed from 20 $ft^2$/acre pre-burn to 17.6 $ft^2$/acre post-burn.

*High volumes of fallen trees and other woody debris*

On the 7 Vista plots, the total woody fuel load was 19.1 tons/acre pre-burn, including 14.6 tons/acre of fuels greater than 3" in diameter. Post-burn, the total fuel load was 11.5 tons/acre, with 8.9 tons/acre of fuels greater than 3" in diameter.

*High plant species richness, including hardwoods*

We have not collected data on the Vista plots for a long enough period of time to evaluate this element. In general, however, we expect that thinning of the canopy as well as reduction of fuel loads on the forest floor should allow increased diversity. Patches of high intensity fire within the burn may create opportunities for regeneration of aspen, one of the few common hardwoods in the mixed-conifer vegetation type. The Vista plots contained 10.9 aspen trees/acres in the 6-12" and 12-18" DBH size classes, post-burn.

*Adequate levels of residual plant cover to maintain fruits, seeds, and regeneration to provide for the needs of Mexican spotted owl prey species*

Again, we do not yet have enough data from the Vista plots to evaluate residual plant cover. Our monitoring experience from prescribed fires suggests that low intensity fire leaves a mosaic of residual plant cover, and also allows plant cover to return rapidly.

### *Canyon habitat*

Overall, little overlap of wildland fire use fires and canyon habitat is expected. If this does occur, it is likely to be in areas where canyon habitat also displays many of the characteristics of forest habitat.

*Cooler and often more humid conditions than the surrounding area*

This element would only be affected by wildland fire use where it was dependent on vegetation rather than topography.

*Clumps or stringers of trees and/or canyon wall containing crevices, ledges, or caves*

Clumps or stringers of trees could be affected as described above in the discussion of forest habitat. Other elements would not be affected.

*High percent of ground litter and woody debris*

Woody debris could be removed by a wildland fire use fire, as discussed above.

*Riparian or woody vegetation (although not at all sites)*

Woody vegetation could be affected as described above, but it is highly unlikely that riparian vegetation would be affected by wildland fire use.

### *Effects determination*

Among the specific guidelines for management of restricted habitat, the Recovery Plan states:

> *Management priority should be placed on reducing identified risks to spotted owl habitat. The primary existing threat is catastrophic wildfire. Thus, we strongly encourage the use of prescribed and prescribed natural fire to reduce hazardous fuel accumulations.* (U.S. Fish and Wildlife Service 1995d, p. 94)

Preliminary results from our monitoring program indicate that low intensity wildland fire use fires will allow us to reduce the risk of catastrophic wildfire, while still maintaining and developing the primary constituent elements of critical habitat overall. Our fire effects data and burn severity analyses

suggest that any potential adverse effects of wildland fire use fires to spotted owl critical habitat would be limited to small patches of moderate to high intensity fire. For that reason, we believe that the protective benefits of treating critical habitat through wildland fire use will outweigh any negative effects over the long term. However, because some short-term undesired effects may occur, we conclude that the wildland fire use program may adversely affect Mexican spotted owl critical habitat in the short term.

### POTENTIAL FOR CUMULATIVE EFFECTS OF NON-FEDERAL ACTIONS TO MEXICAN SPOTTED OWL CRITICAL HABITAT

We are aware of no other non-federal activities occurring in or around the project area which would cause cumulative effects, adverse or otherwise, to Mexican spotted owl critical habitat.

# XV. CALIFORNIA CONDOR

## BACKGROUND

The California condor (*Gymnogyps californianus*) is a member of the family Cathartidae or New World vultures, a family of seven species, including the closely related Andean condor (*Vultur gryphus*) and the turkey vulture (*Cathartes aura*) (U.S. Fish and Wildlife Service 1996).

California condors are among the largest flying birds in the world. Adults weigh approximately 10 kilograms (22 lbs.) and have a wing span up to 2.9 meters (9.5 ft). Adults are black except for prominent white underwing linings and edges of the upper secondary coverts. The head and neck are mostly naked, and the bare skin is gray, grading into various shades of yellow, red, and orange. Males and females cannot be distinguished by size or plumage characteristics (U.S. Fish and Wildlife Service 1996).

The California Condor was listed as endangered on March 11, 1967, in a final rule published by the U.S. Fish and Wildlife Service. The Service then established critical habitat for the California condor nine years later on September 24, 1976. Long recognized as a vanishing species, the California condor remains one of the world's rarest and most imperiled vertebrate species. Despite intensive conservation efforts, the wild California condor population declined steadily until 1987, when the last free-flying individual was captured. During the 1980s, captive condor flocks were established at the San Diego Wild Animal Park and the Los Angeles Zoo, and the first successful captive breeding was accomplished at the former facility in 1988. Following several years of increasingly successful captive breeding, captive-produced condors were first released back to the wild in early 1992 (U.S. Fish and Wildlife Service 1996).

In 1996, condors were released into the Vermilion Cliffs area in Coconino County, Arizona, approximately 60 miles north of Grand Canyon National Park. The released birds in Arizona are characterized as a "10(j)" population. This refers to its experimental population status under section 10(j) of the Endangered Species Act. By declaring the population "non-essential, experimental", the Fish and Wildlife Service can treat condors in the project as "threatened" and develop regulations for management of the population that are less restrictive than mandatory prohibitions covering endangered species. This designation provides increased opportunities for assuring that the release and management of the condors does not disrupt or conflict with other activities. Within Grand Canyon National Park, the condor has the full protection of a threatened species.

## CONDOR SURVEYS IN GRAND CANYON NATIONAL PARK

Following the release of condors in Arizona in 1996, the birds have matured and become skilled flyers, moving farther and farther from the release site.

Each bird has been fitted with a radio transmitter that allows accurate tracking of their movements and behavior. The monitoring plan in the final environmental assessment dealing with the condor release calls for continued tracking of the birds for the first two to three years following their release (Peregrine Fund 1996). Although ground triangulation is the primary means of radiotracking, aerial and satellite tracking methods are also used to locate birds.

Since the time of the initial release in Arizona of immature birds in 1996, data on bird activity away from the release site have been collected by the Peregrine Fund and by Grand Canyon National Park.

In addition to the Grand Canyon area, condors have been observed west to the Virgin Mountains near Mesquite, Nevada, south to the San Francisco Peaks near Flagstaff, Arizona, north to Zion and Bryce Canyon National Parks and beyond Minersville, Utah, and east to Mesa Verde, Colorado, and the Four Corners region.

Monitoring data indicate that the condors are using habitat throughout the park, with concentration areas in Marble Canyon, Desert View to the Village on the South Rim, and the Village to Hermits Rest on the western portion of the South Rim. The majority of summer activity of the birds occurs on the South Rim, but includes both North and South Rim visitation areas.

#### CONSERVATION MEASURES FOR THE CALIFORNIA CONDOR AND ITS HABITAT

The following conservation measures have been adopted as part of the project description, and will be adhered to during project operations, **unless such adherence compromises safety**.

- All helicopter dip tanks will be covered when not in use.
- All fire personnel will be provided literature or instructed regarding condor concerns.
- Any presence of condors in the project area will be recorded and reported immediately to the Resource Advisor.
- If condors arrive at any area of human activity associated with wildland fire use activities, the birds will be avoided. The assigned Resource Advisor or a park wildlife biologist will be notified, and permitted personnel will haze the birds from the area.
- No non-permitted personnel will haze condors.
- All camp areas will be kept free from trash.
- Aircraft use along the rim of the Grand Canyon will be minimized to the greatest extent possible.
- Aviation personnel will contact the Peregrine Fund daily (at 520-606-5155 or 520-380-4667) during wildland fire use operations involving aviation to check on locations of condors.

- If any fire retardant chemicals must be used, the application area will be surveyed and any contaminated carcasses will be removed before they become condor food sources.
- Aircraft will remain 400 meters from condors in the air or on the ground unless safety concerns override this restriction.
- If airborne condors approach aircraft, aircraft will give up airspace to the extent possible, as long as this action does not jeopardize safety.
- The park will adhere to the air quality standards set by the Arizona Department of Environmental Quality.

#### EFFECTS OF THE PROPOSED ACTION ON THE CALIFORNIA CONDOR AND ITS HABITAT

### *Fire*

The mobility of condors, and the fact that they rarely nest in forested habitat, make the possibility of direct mortality from fire highly unlikely.

### *Noise and Visual Disturbance*

Although most management of wildland fire use fires involves minimal activity, if suppression actions are necessary, the noise and activity associated with fireline construction, helicopter water drops, and crew staging areas could potentially disturb condors in the area. Studies of the physiological and behavioral responses of condors to noise and visual stimuli have not been undertaken, but such effects have been studied in other raptor species. A discussion of the these effects can be found in the previous section on the Mexican spotted owl. The studies discussed suggest that disturbance from wildland fire use activities could range from none at all to flushing birds from perching, roosting, or scavenging sites.

Although general disturbance from noise and activity is possible, it is also likely that condors will be attracted to any areas with high levels of activity associated with wildland fire use operations. Condors are naturally curious and it is not uncommon to observe them in busy areas, such as Grand Canyon Village on the South Rim. During the Vista wildland fire use fire of 2001, 15 condors had to be hazed from the North Rim helibase water tank several times. This problem was resolved by covering the water tank, after which these condors stopped returning. After this all water tanks were covered when not in use, and this practice has been adopted as a conservation measure.

This attraction to busy sites may increase the potential for interaction between condors and humans, which would be of concern if non-permitted personnel haze the birds, or if the birds become habituated to humans. Educating firefighters and other personnel about condor concerns (as described in the conservation measures, above) will reduce potential disturbance from suppression and monitoring activities. Normal mitigation

measures in construction projects require crews to stop activity if condors arrive on the site. However, it will not be possible for firefighters to cease activity if condors are attracted to fireline construction areas. Instead, the resource advisor assigned to the fire will be notified of the presence of condors and will arrange for hazing of the condors by permitted personnel. This will reduce the likelihood of negative effects to condors from human interactions.

### *Smoke*

Condors are highly mobile birds, able to travel over 100 miles in a single day, and using home ranges of well over a million acres (U.S. Fish and Wildlife Service 1996). Because of their mobility, and the fact that they are not closely tied to one small habitat area, they should be able to easily escape any smoke generated by wildland fire use fires. Negative effects would be limited to minor disturbance in most situations.

The only occasion when smoke might present a major disturbance or hazard would be if large amounts of smoke were to enter the canyon near nesting condors. Because the condors are monitored via radiotelemetry, the locations of any nests should be known, and this information would be incorporated into any decision to proceed with a wildland fire use fire.

Nesting condors would be additionally protected by the park's adherence to the ADEQ air quality standards. The park is a Mandatory Federal Class I area for air quality under the Clean Air Act, making the park, and fire management, subject to stringent air quality standards set by the Arizona Department of Environmental Quality (ADEQ). Amounts of smoke which would be associated with a violation of the ADEQ standards would also be likely to pose risks for visitors, and by extension, to wildlife. Because such a violation would be a serious problem for the park, every effort is made to avoid this during any prescribed fire or wildland fire use operation. First, such operations are only conducted when weather forecasts and current conditions indicate that smoke will be carried up and away from the canyon on the prevailing southwest winds. Second, various methods of air quality monitoring (dataRAM particulate monitors, transmissometers, photo points) are employed at several locations in Grand Canyon during such operations. The data collected is analyzed on a continuous basis and the results are passed on to fire managers and to ADEQ. If an impending violation is detected, fire managers will adjust management strategies to reduce smoke production and avoid the violation. These factors should help to prevent serious negative effects to less mobile nesting condors.

### *Collisions with Aircraft*

Based upon observations made during the wildland fire use fires of 2001, the park helicopter and condors are sharing the same airspace. Although there have been no collisions or near-collisions, the potential does exist. There are

no data available documenting the number of collisions between aircraft and birds within Grand Canyon National Park (Grand Canyon Airport Tower, pers. comm.).

The final environmental assessment for the condor release at Vermilion Cliffs states that:

> *The release should not affect operations at the Marble Canyon or Cliff Dwellers airstrips. There are no records in the literature describing condor collisions or near-collisions with aircraft. Further, the risks to aircraft from soaring condors should be no greater than those from other large bird species (golden eagles and turkey vultures) already present in the area. The condors' large size and predictable flight patterns make them highly visible to pilots and help to minimize aircraft risks*. (Peregrine Fund 1996).

The environmental assessment does not address proximity of condors to helicopter flight operations during fire suppression activity. It is reasonable to assume that any increased aviation activity associated with wildland fire use, and the possible attraction of condors to other wildland fire use activity, could increase the overall risk of a collision somewhat.

It is important to note that a collision with a condor would be a serious hazard to the safety of any aircraft, and for that reason, will be avoided at all costs by the pilot. We expect that the conservation measures that are in place, as well as general aviation safety practices, will keep the probability of collisions low, and that there will be no negative effects to condors from wildland fire use-related aviation.

### *Damage to habitat*

Wildland fire use projects have the potential to damage condor roosting habitat within project areas. Some roost sites, such as large trees or snags, could be damaged, but most would only be temporarily unavailable while fire was present. Because many roosting sites are available throughout the Park, and condors could easily move to those sites, negative effects would be more related to disturbance than to permanent habitat damage.

Wildland fire use projects also have some potential to contaminate condor food sources. Although it would not be a usual project-related event, it is possible that aerially-applied fire retardant might be used in suppression activities. If this were to occur, the application area would be surveyed as soon as possible following the application so that any contaminated carcasses could be removed before becoming condor food sources.

## EFFECTS DETERMINATION

Wildland fire use activities may increase the potential for condors' habituation to humans, for collisions between condors and aircraft, for damage to condor habitat, and for disturbance to condors by personnel, aircraft, or smoke. Although we feel that, with the above-stated conservation measures in place, the potential for these effects to occur is small, it does exist. For that reason, we conclude that the project may adversely affect the California condor.

### POTENTIAL FOR CUMULATIVE EFFECTS OF NON-FEDERAL ACTIONS TO THE CALIFORNIA CONDOR

We are aware of no non-federal actions that would cause cumulative effects to the California condor or its habitat.

# XVI. SUMMARY OF CONSERVATION MEASURES

The following conservation measures have been adopted as part of the project description, and will be adhered to during project operations, **unless such adherence compromises safety**.

## GENERAL CONSERVATION MEASURES

General conservation measures which apply to all wildland fire use projects were discussed in section II, Background Information and Project Description. These measures include:

- Using only low intensity fires for wildland fire use
- Monitoring fire effects for adaptive management
- Reporting results to U.S. Fish and Wildlife Service
- Planning to minimize negative impacts
- Adherence to conservation measures

## SPECIES-SPECIFIC CONSERVATION MEASURES

### *Sentry milk-vetch*

- No wildland fire use fires, and no firefighting (or firefighting-related) activities, will be allowed to encroach upon any known sentry milk-vetch population.
- If unsurveyed areas of potential habitat are included within the project boundary for a wildland fire use fire, we will evaluate the potential for fire to enter the habitat. If it appears that fire could move through the potential habitat, we will survey this habitat before fire reaches it. Fire will not be allowed to enter any habitat found to be occupied.

### *Brady pincushion cactus*

- None needed.

### *Kanab ambersnail*

- Erosion control measures will be used if needed.

### *Humpback chub*

- Erosion control measures will be used if needed.

### *Humpback chub critical habitat*

- Erosion control measures will be used if needed.

### *Southwestern willow flycatcher*

- The park will adhere to the air quality standards set by the Arizona Department of Environmental Quality.

### *Southwestern willow flycatcher critical habitat*

- None needed.

### *Bald eagle*

- The park will adhere to the air quality standards set by the Arizona Department of Environmental Quality.

### *Desert tortoise*

- None needed.

### *Mexican spotted owl*

- Park wildlife biologists will be consulted early in the decision-making process for wildland fire use fires.
- To minimize negative effects on habitat, wildland fire use fires will be managed as low-intensity fires, as discussed in the project description. Our objective will be to limit mortality of trees greater than 18" DBH to less than 5% across the project area. While natural fire starts will not be allowed to burn if fire managers anticipate mortality greater than 5% in large trees ($\geq$ 18" DBH), we recognize that occasionally up to 10% mortality may occur in large trees because fire is not a precision tool.
- The park will adhere to the air quality standards set by the Arizona Department of Environmental Quality.
- If fireline construction is necessary, we will minimize the cutting of trees and snags larger than 18" DBH, and no trees or snags larger than 24" DBH will be cut unless absolutely necessary for safety reasons.
- If fireline construction is necessary, we will rehabilitate the line after use. This will be done by pulling soil, duff, litter, woody debris, and rocks back onto the line to bring it up to grade and to make it blend in with the surrounding area.
- If new fire-related activity centers, such as dip sites or drop points, are necessary, these will be located at least 400 meters from the boundary of any designated Protected Activity Center.
- To the maximum extent possible, aircraft will remain at least 400 meters from the boundary of any designated Protected Activity Center.

- If Mexican spotted owls are discovered during project activities, a park wildlife biologist will be notified immediately.
- Firefighters will not approach or haze Mexican spotted owls, if found.
- We will survey known PACs that can be surveyed from the rim, and that are adjacent to potential wildland fire use areas as described in this document.
- We will consider limiting the movement of fire over the rim and into PACs on a case-by-case basis, through consultation between resource managers and fire managers.
- We will adhere to the recommendations set out in the USFWS memo, "*Clarification of Recommendations in the Recovery Plan for the Mexican Spotted Owl in Regards to Prescribed Natural Fire"*, dated 2 September 1997, which is included as Appendix I.

### *Mexican spotted owl critical habitat*

- Park wildlife biologists will be consulted early in the decision-making process for wildland fire use fires.
- To minimize negative effects on the primary constituent elements of critical habitat, wildland fire use fires will be managed as low-intensity fires, as discussed in the project description. Our objective will be to limit mortality of trees greater than 18" DBH to less than 5% across the project area. While natural fire starts will not be allowed to burn if fire managers anticipate mortality greater than 5% in large trees ($\geq$ 18" DBH), we recognize that occasionally up to 10% mortality may occur in large trees because fire is not a precision tool.
- If fireline construction is necessary, we will minimize the cutting of trees and snags larger than 18" DBH, and no trees or snags larger than 24" DBH will be cut unless absolutely necessary for safety reasons.
- If fireline construction is necessary, we will rehabilitate the line after use. This will be done by pulling soil, duff, litter, woody debris, and rocks back onto the line to bring it up to grade and to make it blend in with the surrounding area.

### *California condor*

- All helicopter dip tanks will be covered when not in use.
- All fire personnel will be provided literature or instructed regarding condor concerns.
- Any presence of condors in the project area will be recorded and reported immediately to the Resource Advisor.
- If condors arrive at any area of human activity associated with wildland fire use activities, the birds will be avoided. The assigned Resource Advisor or a park wildlife biologist will be notified, and permitted personnel will haze the birds from the area.
- No non-permitted personnel will haze condors.
- All camp areas will be kept free from trash.

- Aircraft use along the rim of the Grand Canyon will be minimized to the greatest extent possible.
- Aviation personnel will contact the Peregrine Fund daily (at 520-606-5155 or 520-380-4667) during wildland fire use operations involving aviation to check on locations of condors.
- If any fire retardant chemicals must be used, the application area will be surveyed and any contaminated carcasses will be removed before they become condor food sources.
- Aircraft will remain 400 meters from condors in the air or on the ground unless safety concerns override this restriction.
- If airborne condors approach aircraft, aircraft will give up airspace to the extent possible, as long as this action does not jeopardize safety.
- The park will adhere to the air quality standards set by the Arizona Department of Environmental Quality.

## XVII. SUMMARY OF EFFECTS DETERMINATIONS

### *Sentry milk-vetch*

- May affect, not likely to adversely affect

### *Brady pincushion cactus*

- No effect

### *Kanab ambersnail*

- May affect, not likely to adversely affect

### *Humpback chub*

- May affect, not likely to adversely affect

### *Humpback chub critical habitat*

- May affect, not likely to adversely affect

### *Southwestern willow flycatcher*

- May affect, not likely to adversely affect

### *Southwestern willow flycatcher critical habitat*

- No effect

### *Bald eagle*

- May affect, not likely to adversely affect

### *Desert tortoise*

- No effect

### *Mexican spotted owl*

- May adversely affect

### *Mexican spotted owl critical habitat*

- May adversely affect

### *California condor*

- May adversely affect

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# BIOLOGICAL EVALUATION

# for

# PRESCRIBED FIRE

# in

# GRAND CANYON NATIONAL PARK,

# COCONINO COUNTY, ARIZONA

**April 2003**

**DOCUMENT REVIEW**

Prepared by:_____
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Approved by:_____
R.V. Ward, Wildlife Biologist, Program Director

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# I. INTRODUCTION

As part of a comprehensive fire management program, Grand Canyon National Park (GCNP) intends to use prescribed fire in order to achieve resource benefits. The Prescribed Fire program is described under the 1995 Fire Management Plan. This biological evaluation describes the rationale for including prescribed fire in the park's fire program, the likely effects of prescribed fire on threatened and endangered species, and the conservation measures that will be implemented by the park to mitigate any negative effects to these species. The full scope of the project will be discussed in the following section.

# II. BACKGROUND INFORMATION AND PROJECT DESCRIPTION

## OVERVIEW OF GRAND CANYON NATIONAL PARK'S NATURAL RESOURCES

Grand Canyon National Park encompasses 1.2 million acres in northern Arizona. Over 1 million acres of the park are proposed for wilderness designation and are managed by the Park Service as if they were designated wilderness. The Grand Canyon region is one of the most ecologically diverse in North America, with five of the seven life zones (Lower Sonoran, Upper Sonoran, Transition, Canadian, and Hudsonian) occurring in the park (National Park Service 1997). Within the inner canyon, at the lowest elevations (below 5000 feet), are several riparian woodland and scrub communities, as well as a variety of warm desert scrub associations with species characteristic of both Sonoran and Mohave deserts. At higher elevations within the canyon, and on the plateaus surrounding the canyon, are several cold desert scrub associations, with species characteristic of Great Basin desert. Interspersed with these communities, and at higher elevations, are pinyon-juniper woodlands (4000 – 7500 feet). Above these are the forest associations, including pure ponderosa pine (7500 – 8000 feet), ponderosa mixed with white fir and other conifers (8000 – 8800 feet), and spruce-fir at the highest elevations (above 8800 feet). Appendix A contains a map of the forest vegetation types. Some grassland communities, including mountain meadows and semi-desert shrub-grasslands, also occur within the park (Warren et al. 1982). The park's broad variety of habitat supports about 1,500 plant species, 340 bird species, 90 mammal species, 60 reptile and amphibian species, and 25 fish species.

## FIRE'S ROLE AT GRAND CANYON NATIONAL PARK

Fire has been a significant influence in the development and maintenance of many of the vegetative communities at Grand Canyon National Park. Over thousands of years, the forests, woodlands, and grasslands have evolved with various fire regimes, most of which have been increasingly altered by human activities. Of the vegetation types in which disturbance patterns have been changed, the forested communities have been among the most severely affected.

Before Euro-American settlement, the lower-elevation conifer forests of the southwest typically experienced frequent, low-intensity surface fires. These fires generally did not harm large trees, but they did limit the survival of seedlings. They also regularly consumed materials on the forest floor, releasing nutrients, and occasionally provided openings for tree regeneration or release. The resulting forests had a diverse, open structure, with little invasion of shade-tolerant understory species (Wolf and Mast 1998).

In general, the fire return interval in southwestern ponderosa forests was 2 to 20 years prior to Euro-American settlement (Fulé et al. 1997). Wolf and Mast (1998) reconstructed long-term fire histories for pre-Euro-American

settlement (prior to 1870), settlement (1870-1919), and fire suppression (1920-1995) eras for the North Rim of Grand Canyon National Park. This study indicated that the fire return interval prior to 1870 ranged from 4.85 years at the lowest elevations to 10.30 years at the highest elevations. Another study conducted in ponderosa and mixed-conifer forest in the park found mean fire return intervals ranging from 2.97 years to 6.54 years, with lower elevation sites experiencing greater fire frequency (Covington et al. 2000). This elevational gradient of increasing fire return interval continues into the highest-elevation spruce-fir forest. These forests may experience some low-intensity fire, but depend more on a low-frequency, high-intensity stand-replacement fire regime for maintenance and renewal (White and Vankat 1993).

When considering fire return intervals, it is important to note that these represent averages across an area. They do not reflect the typically patchy nature of low-intensity fires, in which some areas tend to burn in every fire, while other areas burn only rarely.

Fire regimes throughout the southwest and in the park have been disrupted by a range of human activities, particularly since Euro-American settlement. In the park, one of the most important factors was heavy, unrestricted livestock grazing, which began in the late 1800's (National Park Service 1997). Grazing reduced the fine fuels that had carried the frequent low-intensity fires through the ponderosa forests. Less fire and reduced competition from grasses allowed more young trees to become established. When fire suppression began in the 1920's, these changes were strongly reinforced.

The changes that have occurred due to these disruptions have, in general, been more severe in the sites with the shortest fire return intervals, as more fires have been missed. These forests now have much higher tree density, fuel loads, canopy closure, fuel continuity, and landscape homogeneity than they had in the past (Covington and Moore 1994). This has resulted in decreased diversity, forage production, and nutrient cycling, while increasing the potential for outbreaks of disease and insect infestation. It has also greatly increased the risk of large, severe, stand-replacing wildfires.

Recent very large, high-severity fires throughout the southwest are evidence of the magnitude of the problem. In the park, as elsewhere, forested habitat is at great risk of sudden, rapid loss. Equally at risk are the human developments bordering or surrounded by these forests. For these reasons, fire management at Grand Canyon currently deals almost exclusively with these forested areas.

### OVERVIEW OF FIRE MANAGEMENT PROGRAM

Until 1978, when a prescribed fire program was introduced, fire suppression was the only fire management option for the park. Since that time, the fire

management program has grown, and today involves wildfire suppression, prescribed fire, wildland fire use (the management of naturally ignited fires), and mechanical treatments in urban interface areas.

A new fire management plan is currently being developed for the park. Until the new plan is completed, the fire management program continues to be guided by the 1992 Wildland Fire Management Plan (National Park Service 1992), which was revised in 1993, 1994, and 1995, and amended in 1998 to address new fire policies and park plans. A biological evaluation was written for the 1992 plan, but that evaluation is now out of date due to various changes, including the listing of the Mexican spotted owl and the designation of its critical habitat. A new consultation with the U.S. Fish & Wildlife Service will be completed for the new fire management plan. This document, covering the prescribed fire program and mechanical treatments in urban interface areas, will serve as an intermediate step toward that larger consultation.

The goal of the fire management program, as stated in the 1992 Wildland Fire Management Plan, is "to effectively manage wildland fire and provide for the protection of life, property, and cultural resources, while ensuring the perpetuation of park ecosystems and natural resources". This goal is related to, and supports, several of the management objectives outlined in the park's General Management Plan (National Park Service 1995). These include:

- *To the maximum extent possible, restore altered ecosystems to their natural conditions.*
- *Manage ecosystems to preserve critical processes and linkages that ensure the preservation of rare, endemic, and specially protected (threatened/endangered) plant and animal species.*
- *Preserve, protect, and interpret the park's natural and scenic resources and values, and its ecological processes.*
- *Preserve and protect the genetic integrity and species composition within the park, consistent with natural ecosystem processes.*
- *Inventory, monitor, and maintain data on park natural and cultural resources and values, and utilize this information in the most effective ways possible to facilitate park management decisions to better preserve the park.*

The fire management program also supports many of the management objectives identified in the park's Resource Management Plan (National Park Service 1997). One of the natural resource objectives stated in this plan relates directly to the fire management program:

- *Reintroduce and maintain fire's natural role in Park ecosystems to the maximum extent possible.*

Other natural resource management objectives that relate to the fire management program are:

- *Through the development and operation of a science-based comprehensive natural resource inventory and monitoring program, develop and maintain an understanding of the status and trends of populations, communities, and ecosystems, and the phenology of the resource.*
- *Restore, enhance, and protect populations of threatened or endangered species.*
- *Preserve the natural genetic integrity and species composition within the Park, consistent with ecosystem processes, including the elimination of nonnative plant and animal species wherever possible.*

To meet these objectives, the fire management program employs all of the tools available to fire managers -- fire suppression, prescribed fire, wildland fire use, and limited mechanical thinning. All of these activities can be useful in fulfilling these objectives, but they also have the potential to work against many of the same objectives. In almost all situations, the fire management program must carefully balance the positive and negative effects of fire and fire management activities.

In order to determine if the program is successfully achieving this balance and meeting objectives, the fire management program includes a monitoring program. According to the National Park Service Reference Manual 18 (National Park Service 1999), which provides guidance on wildland fire management, all National Park Service units using prescribed fire must implement a standardized vegetation monitoring program to track fire effects and to ensure that fire management resource objectives are met. The fire effects monitoring program at Grand Canyon began in 1989 and has a current network of over 100 permanent plots stratified by seven vegetation types. Plots are visited pre-burn, post-burn, and one, two, and five years after prescribed fires, and when possible, after wildland fire use fires. Overstory and pole-sized trees, seedlings, shrubs, herbaceous vegetation, and fuel loading are measured. Detailed monitoring protocols are outlined in the NPS Fire Monitoring Handbook, which can be found at: **www.nps.gov/fire/fmh/FEMHandbook.pdf**.

Fire monitoring efforts have also recently expanded to include burn severity mapping using satellite imagery, which helps us gain a broader view of fire effects across each project area. A satellite view of a recently burned area is acquired and the view is classified into areas of different burn severity. The burn severity classes are defined as follows:

> ***Unburned****: No evidence of fire.*
>
> ***Low****: Fire was nonlethal to the dominant vegetation. Fire did not alter the structure of the dominant vegetation. Scattered small, unburned patches intermixed within burn area. Scorching of vegetation limited to 1 meter high or less. Small organic material on*

*ground scorched, but not entirely consumed. Most foliage and twigs intact. Mineral soil intact.*

***Low-to-Moderate**: Partial scorching of foliage and fine materials on vegetation. Minimal consumption of foliage and fine materials on vegetation. Most overstory green vegetation remains. Limited overstory tree mortality. Few, if any, unburned patches within the burn area. Most fine organic materials partially consumed, with minimal consumption of large logs. Rotten wood scorched to partially burned. Mineral soil generally intact.*

***Moderate-to-High**: Fire scorched most of the foliage and fine materials on vegetation. Partial consumption of foliage and fine materials on vegetation. Limited green vegetation remains in overstory. Partial overstory tree survival expected. Intermittent patches within burn area have large logs as well as all organic materials consumed to bare mineral soil. Most woody debris consumed. Mineral soil partially altered.*

***High**: Fire killed above ground parts of all vegetation, changing the forest structure substantially. All foliage and fine materials on vegetation consumed. Most large logs as well as all organic material on the ground consumed. All forest litter and duff consumed, exposing and altering bare mineral soil.*

Next, ground-truthing is conducted to determine the accuracy of the classification. We have found that the classification method accurately predicts the burn severity observed on the ground. This allows us to use the satellite image to quantify areas of different burn severity within the burn. An example of the results is shown in the map of the Vista fire in Appendix B, and more information on the process can be found at: **http://edc2.usgs.gov/fsp/severity/fire_main.asp**.

We are also considering additional ways to expand the monitoring program and to continue to improve our ability to answer questions about fire at Grand Canyon, and to better understand fire ecology at a landscape scale.

Issues of scale have become increasingly important to fire managers in recent years. The occurrence of many large, severe wildfires has underscored the need to find ways to apply fuel reduction treatments at the scale needed to reduce hazards over large areas.

This is as true at Grand Canyon as it is elsewhere. Park management plans have stated goals of restoring altered ecosystems to their natural conditions, preserving critical ecosystem processes, and reintroducing and maintaining fire's natural role in park ecosystems to the maximum extent possible (National Park Service 1995 and 1997). The park has over 120,000 acres of forested habitat; most of these acres are not yet in a condition where a

natural fire regime can safely be allowed to resume. Currently, we are not treating enough acres annually to achieve that ultimate goal, and to protect our forests adequately from catastrophic fire. To date, the largest acreage treated within a single year in the park, wildfires excluded, was just over 11,000 acres, which occurred in 1998 and also in 2001 (GCNP fire records, on file at GCNP fire offices). As an example, to simulate a mid-range historical fire return interval of 6 years, an average of 20,000 acres would need to be treated each year. Even achieving a longer fire return interval of 20 years would require that an average of 6000 acres be treated annually; we have achieved that level of treatment in only two additional years. The prescribed fire and limited mechanical thinning programs are our only active method for treating these acres.

**PRESCRIBED FIRE PROGRAM:**

Prescribed fires are fires that are intentionally ignited to accomplish management objectives in specific areas under prescribed conditions, as identified in an approved prescribed fire plan. Specific plans are developed for individual burns. The long-term management objectives, as outlined in the current Fire Management Plan (1995), for this program are:

1. Protect life and property from the threat of wildfire by reduction of hazardous fuel accumulations associated with values at risk, specifically in areas surrounding park developments and adjacent to predetermined boundary areas.

2. Utilize management ignited prescribed fire/prescribed burns to facilitate the expansion of the prescribed natural fire (fire use) program into a larger geographic area of the park.

3. Restore fuel loadings and ecosystem structure in vegetative communities which have been significantly altered by past fire suppression activities.

4. Monitor and evaluate the effects of fire management activities on park ecosystems.

In order to better achieve these objectives the park has been divided into three Fire Management Zones. These zones distinguish broad areas with " 6'similar habitat types. To achieve further specificity, the forested areas of the park have been divided into fire monitoring types and burn units. These burn units are defensible areas that may be treated in a single or multiple burn periods and may contain one or more fire monitoring types (see Appendix A: Burn Units/Project Areas Map).

In order to achieve the desired resource benefits, prescriptions have been designed to result in primarily low intensity fires, with only scattered high intensity patches within the perimeter of the fire. Throughout this document we make general references to low intensity as meaning fire that will remain a surface fire, moving into the crowns of mature trees only occasionally, and will cover the fire intensity categories low-intensity and low-moderate intensity . Low intensity fires will not be stand-replacing fires. The fire will thin smaller trees, reduce available fuels, and release nutrients, and will cause little damage to the largest trees. We also make general references to high or higher intensity fire which include the moderate – high and high fire intensity categories.

**PROJECT DESCRIPTION:**

Grand Canyon's Fire and Aviation Branch have planned to initiate 23 projects over the next five years that will be consulted on under this biological evaluation. These projects will occur in the South Rim Ponderosa Pine, North Rim Ponderosa Pine, and Ponderosa Pine with White Fir Encroachment (mixed-conifer) fire monitoring types (see Appendix D: Monitoring Types/Fire Objectives). These projects may take place any time weather conditions are favorable but will primarily occur in the Fall and Spring.

Management of these fires will involve hand and aerial ignition as well as the construction of fireline. After ignition management will be relatively unobtrusive, with few personnel visiting the fire on a regular basis to monitor its behavior and progress. However, if monitoring indicates that the fire is not achieving the desired resource benefits, the decision may be made to suppress the fire, in whole, or in part. If suppression actions become necessary, greater levels of activity and habitat disturbance will also be necessary. Suppression activities could include fireline construction, helicopter water drops, aerial application of retardant, or other suppression activities.

**GENERAL RESOURCE PROTECTION AND CONSERVATION MEASURES FOR THE PRESCRIBED FIRE PROGRAM**

In order to ensure that the effects of the prescribed fire program on park resources are positive, we will employ the general resource protection and conservation measures described below.

### *Prescribing only low intensity fires*

As discussed above, prescribed fires must remain at primarily low intensity, with only scattered high intensity patches, to be allowed to continue as a prescribed fire.

### *Monitoring fire effects for adaptive management*

We will monitor the effects of the prescribed fires we propose to conduct in order to provide the information necessary to allow adaptive management. Our efforts will include monitoring fire behavior while fires are ongoing and providing feedback to fire managers. We will also include long-term monitoring through the existing fire effects program. We will also include remotely sensed burn severity monitoring, and may introduce new methods as necessary.

### *Reporting results to U.S. Fish and Wildlife Service*

We will maintain a record of fire-related activities of interest to the Service. Resource advisors will collect information including: fire size; estimated number of large (>18" DBH) trees and snags cut; amount and type of disturbance involved in construction of fire support sites if required; types of aircraft used; number, size, and location of water drops if required; and amount of fire that drops over canyon rim. We will also provide any available information on fire behavior and fire effects as needed, including fire effects monitoring data, fire effects plot data and burn severity data.

### *Planning to minimize negative impacts*

The park's Cultural and Natural Resource Branches will be informed of prescribed fire projects well in advance. Prescribed fires will not proceed without proper survey for sensitive resources. Conservation measures will be implemented to minimize negative effects to sensitive species. These conservation measures as well as a review of the status of the sensitive species in the park are provided in the following sections.

Minimizing the need for suppression activities, both planned and unplanned, is critical to maximizing positive effects and minimizing negative effects of prescribed fire projects. In order to do this, whenever fire suppression activities are necessary, we will employ Minimum Impact Suppression Tactics (MIST) (Appendix E) in order to minimize negative effects. Additional park-specific resource protection guidelines (Appendix F) will be provided to fire personnel, and specific direction to fire personnel will be provided by the Park's Natural Resource Branch.

### *Adherence to conservation measures*

The conservation measures in Appendices E and F are considered to be part of the project description for all prescribed fires, as are the conservation measures for individual species described later in this document. They are not considered optional or discretionary, except in rare instances where adherence to those measures would compromise safety.

# III. THREATENED AND ENDANGERED SPECIES THAT MAY OCCUR IN THE PROJECT AREA

Nine federally listed animal and plant species are known to occur in, or might occur in, Grand Canyon National Park. These are as follows:

**ENDANGERED**

- Sentry milk-vetch (*Astragalus cremnophylax var. cremnophylax*)
- Brady pincushion cactus (*Pediocactus bradyi)*
- Kanab ambersnail (*Oxyloma haydeni kanabensis*)
- Humpback chub (*Gila cypha*)
- Southwestern willow flycatcher (*Empidonax traillii extimus*)

**THREATENED**

- Bald eagle (*Haliaeetus leucocephalus*)
- Desert tortoise (*Gopherus agassizii*)
- Mexican spotted owl (*Strix occidentalis lucida*)

**EXPERIMENTAL POPULATION (TREATED AS THREATENED IN NATIONAL PARKS)**

- California condor (*Gymnogyps californianus*)

The remainder of this biological evaluation will discuss the potential effects of these prescribed fire projects on the threatened and endangered species and critical habitat found in the park. For each species, we will discuss the range of possible effects to the species, as well as the conservation measures that we will follow to protect each species.

# IV. SENTRY MILK-VETCH

## BACKGROUND

*Astragalus cremnophylax var. cremnophylax* is a dwarf milk-vetch that is endemic to at least 7 sites on the South Rim of Grand Canyon National Park and four sites on the North Rim. The U.S. Fish and Wildlife Service designated it as endangered throughout its range in 1990 (U.S. Fish and Wildlife Service 1990). The plant occurs in crevices and depressions with shallow soils on Kaibab limestone on a broad platform at the rim of the Grand Canyon. This milk-vetch apparently prefers the unshaded, well-drained soils or limestone pavement in openings in the pinyon-juniper woodland. The plant appears to occur on one specific layer of Kaibab limestone where the limestone forms a minimum-sized bench or "patio." Dominant species in the surrounding community include *Petrophytum caespitosum* (rock-mat), *Pinus edulis* (pinyon pine), *Juniperus osteosperma* (Utah juniper), *Cercocarpus intricatus* (little-leaf mountain mahogany), *Ephedra viridis* (Mormon tea), *Purshia mexicana* (cliffrose), *Artemesia bigelovii* (sagebrush), *Agropyron smithii* (wheatgrass), and *Poa pratensis* (bluegrass). Sentry milk vetch and rock-mat are the two dominant species in the dwarf plant community that occurs on this limestone pavement (U.S. Fish and Wildlife Service 1990).

*Astragalus cremnophylax var. cremnophylax* is usually less than 2.5 cm (1 inch) high and forms a mat 2.5-25 cm (1-10 inches) in diameter. The short, creeping stems have compound leaves less than 1.0 cm (0.4 inches) long composed of 5--9 tiny leaflets. The fruit is obliquely egg-shaped and densely hairy. Whitish or pale purple flowers are 0.5 cm (0.2 inches) long and appear from late April to early May. Seeds are set in late May to June. The plants appear to be long-lived and have a thick taproot that penetrates the limestone surface to reach a more constant source of moisture (U.S. Fish and Wildlife Service 1990).

## SENTRY MILK-VETCH SURVEYS IN GRAND CANYON NATIONAL PARK

A thorough count of all South Rim plants in 1988 indicated that the population contained 489 plants. A 1989 inventory of the monitoring plots established in 1988 indicated that the population declined by about 10 percent. Data indicate the cause for this decline may have been trampling by park visitors. The effects of trampling on both plants and their habitat may have been amplified by the below average rainfall in 1989. From May 1989 to May 1990, subpopulations experienced from 19 percent to 63 percent mortality, depending on degree of human visitation (U.S. Fish and Wildlife Service 1990).

In 1988, the seedling class comprised only 22.2 percent of the population. Given the trampled condition of most mature plants, a likely explanation for the small proportion of seedlings is that they are killed by trampling. Only those seedlings in sites relatively safe from trampling survive. Poor seed

dispersal may also affect the number of seedlings (U.S. Fish and Wildlife Service 1990). The NPS has rerouted foot traffic and constructed a rail fence around one South Rim sentry milk-vetch population, in an effort to protect the plants from trampling.

In 1994 an additional four populations of sentry milk-vetch were located in the Cape Final area of Grand Canyon's Walhalla Plateau (Unpublished report in GCNP Botanist files). Total population for the four sites is over 1000 plants. In 1998, all other suitable habitat on the Walhalla Plateau was surveyed with negative results. In 2002, 13 miles of habitat along the East Rim Drive was surveyed resulting in an additional six populations located in the Grandview area (see Appendix G).

#### CONSERVATION MEASURES FOR SENTRY MILK-VETCH AND ITS HABITAT

- No prescribed fires, nor fire-related activities, will be allowed to encroach upon known sentry milk-vetch populations.
- If unsurveyed areas of potential habitat are included within the project boundary we will evaluate the potential for fire to enter the habitat. If it appears that fire could move through the potential habitat, we will survey this habitat prior to project implementation. Fire will not be allowed to enter any habitat found to be occupied.

#### EFFECTS OF THE PROPOSED ACTION ON SENTRY MILK-VETCH AND ITS HABITAT

Of the 23 proposed projects, sentry milk-vetch has the potential to occur within proximity to six projects areas (see Appendix A). Because this plant occurs in openings in a vegetation type which is unlikely to carry fire, the potential for affecting sentry milk-vetch populations should be extremely small. In addition, we will survey all potential habitat that may be affected by the prescribed fire projects prior to project implementation. Any populations located will be documented and protected. For these reasons, we conclude that the prescribed fires may affect but will not likely adversely affect sentry milk-vetch.

#### POTENTIAL FOR CUMULATIVE EFFECTS OF NON-FEDERAL ACTIONS TO SENTRY MILK-VETCH OR ITS HABITAT.

We are aware of no non-federal actions that would cause cumulative effects to the sentry milk-vetch or its habitat.

# *V.* BRADY PINCUSHION CACTUS

## BACKGROUND

The Brady pincushion cactus is an inconspicuous plant with a short (3.8-6.2 cm tall), usually solitary, rounded stem. It blooms in April, and may retract into the ground in the dry season. It is restricted to a specific and limited limestone soil type (Kaibab limestone chips overlying Moenkopi shale and sandstone-derived soils) which occurs on benches and terraces in the Marble Gorge area of northern Arizona. Other plants which share its desert habitat include shadscale (*Atriplex confertifolia*), snakeweed (*Gutierrezia sarothrae*), and Mormon tea (*Ephedra viridis*). Its elevational range is 1170 m to 1370 m. It is threatened by off-road vehicle traffic, pesticides, and illegal collection, and was designated as endangered in 1979 (NatureServe Explorer 2001).

## CONSERVATION MEASURES FOR BRADY PINCUSHION CACTUS AND ITS HABITAT

- No conservation measures are necessary, as these projects will not occur in or near Brady pincushion cactus habitat.

## EFFECTS OF THE PROPOSED ACTION ON BRADY PINCUSHION CACTUS AND ITS HABITAT

- The project area does not contain Brady pincushion cactus nor does it contain suitable habitat for Brady pincushion cactus. Therefore, it is our conclusion that this project will have no effect on the Brady pincushion cactus.

## POTENTIAL FOR CUMULATIVE EFFECTS OF NON-FEDERAL ACTIONS TO BRADY PINCUSHION CACTUS OR ITS HABITAT

We are aware of no non-federal actions that would cause cumulative effects to the Brady pincushion cactus or its habitat.

# VI. KANAB AMBERSNAIL

## BACKGROUND

The Kanab ambersnail (*Oxyloma haydeni kanabensis*) is a rare endemic snail restricted to permanently wet areas within small wetlands of the Colorado Plateau. It is a terrestrial snail in the family Succineidae. The empty shell is a light amber color. The live snail has a mottled grayish-amber to yellowish-amber colored shell. The shell is dextral (right handed spiral), thin-walled, with an elevated spire and a broad, patulous (expanded) aperture. Fully mature individuals are about 14 to 19 mm (0.5 to 0.75 inch) long, 7 to 9 mm (0.25 to 0.33 inch) in diameter, with 3.25 to 3.75 whorls in a drawn out spire. Its eyes are borne at the ends of long peduncles (stalks), while the tentacles are reduced to small protuberances at the base of the eye stalks (U.S. Fish and Wildlife Service 1995).

Three populations are known, two in southern Utah, the other within the Grand Canyon of Arizona. A final rule listing the Kanab ambersnail as an endangered species under the authority of the Endangered Species Act, as amended, was published on April 17, 1992 (U.S. Fish and Wildlife Service 1995).

## KANAB AMBERSNAIL SURVEYS IN GRAND CANYON NATIONAL PARK

The Arizona population occurs in a spring fed wetland at Vasey's Paradise, about 32 river miles downstream from Lee's Ferry in Coconino County. The Arizona population at Vasey's Paradise was discovered in 1991. In 1995, the population size at that site was estimated to be around 106,000 individuals (National Park Service 1997).

## CONSERVATION MEASURES FOR THE KANAB AMBERSNAIL AND ITS HABITAT

- No conservation measures are necessary, as these projects will not occur in or near Kanab ambersnail habitat.

## EFFECTS OF THE PROPOSED ACTION ON THE KANAB AMBERSNAIL AND ITS HABITAT

As the snail's habitat, in Marble Canyon, is not near any prescribed fire project we conclude that these projects will have no effect on the Kanab ambersnail.

## POTENTIAL FOR CUMULATIVE EFFECTS OF NON-FEDERAL ACTIONS TO THE KANAB AMBERSNAIL

We are aware of no non-federal actions that would cause cumulative effects to the Kanab ambersnail or its habitat.

# VII. HUMPBACK CHUB

## BACKGROUND

The humpback chub was listed as an endangered species on March 11, 1967. Humpback chub are found in river canyons, where they use a variety of habitats, including pools, riffles, and eddies. They are endemic to the Colorado River basin, with the largest population occurring in the Little Colorado and Colorado Rivers in the Grand Canyon. They are also found in the Black Rocks/Westwater Canyon and Cataract Canyon of the Colorado River, Desolation and Gray Canyons of the Green River, and Yampa and Whirlpool Canyons in Dinosaur National Monument, Green and Yampa Rivers (humpback chub critical habitat designation).

Humpback chub in reproductive condition are usually captured in May, June, or July, and spawning occurs soon after the highest spring flows when water temperatures approach 20°C (68°F). Spring flows and proper temperatures are important for humpback chub; flow reductions and low water temperatures in the Grand Canyon have been identified as factors curtailing successful spawning of the fish and increasing competition from other species (humpback chub critical habitat designation).

## HUMPBACK CHUB SURVEYS IN GRAND CANYON NATIONAL PARK

Surveys and studies of the humpback chub in the park date back at least into the 1970's, and monitoring has been conducted on a more continuous basis since 1990. The humpback chub population in Grand Canyon is estimated to number 2000 with the majority of those occurring near the confluence of the Little Colorado River and the Colorado River.

## CONSERVATION MEASURES FOR THE HUMPBACK CHUB AND ITS HABITAT

- Erosion control measures will be used if needed.

## EFFECTS OF THE PROPOSED ACTION ON HUMPBACK CHUB AND ITS HABITAT

A possible effect would be increased siltation of humpback chub habitat caused by increased erosion following fire. However, this is unlikely to be a problem, because the overall low intensity of the fires will be unlikely to result in erosion problems, and because these fires will be occurring at a distance from humpback chub habitat. In the event that erosion problems became likely, we would mitigate the negative effects through erosion control measures. Because negative effects are so unlikely, we conclude that the prescribed fire program may affect, but is not likely to adversely affect the humpback chub.

## POTENTIAL FOR CUMULATIVE EFFECTS OF NON-FEDERAL ACTIONS TO HUMPBACK CHUB

We are aware of no non-federal actions that would cause cumulative effects to the humpback chub or its habitat.

# VIII. HUMPBACK CHUB CRITICAL HABITAT

### BACKGROUND

The final rule designating critical habitat for the humpback chub was published on March 21, 1994. Known constituent elements for critical habitat include water, physical habitat, and biological environment as required for each particular life stage for each species (humpback chub critical habitat designation).

### HUMPBACK CHUB CRITICAL HABITAT IN GRAND CANYON NATIONAL PARK

The final rule describes the Arizona portion of humpback chub critical habitat as follows:

> *Arizona: Coconino County. The Little Colorado River from river mile 8 in T.32N., R.6E., sec. 12 (Salt and Gila River Meridian) to the confluence with the Colorado River in T.32N., R.5E., sec. 1 (Salt and Gila River Meridian).*
>
> *Arizona: Coconino County. The Colorado River from Nautiloid Canyon (river mile 35) in T.36N., R.5E., sec. 35 (Salt and Gila River Meridian) to Granite Park (river mile 209) in T.30N., RIOW., sec. 25 (Salt and Gila River Meridian).*

### CONSERVATION MEASURES FOR THE HUMPBACK CHUB AND ITS HABITAT

- Erosion control measures will be used if needed

### EFFECTS OF THE PROPOSED ACTION ON HUMPBACK CHUB AND ITS HABITAT

A possible effect would be siltation of humpback chub critical habitat caused by increased erosion following fire. In the event that erosion problems became likely, we would mitigate the negative effects through erosion control measures. Because negative effects are so unlikely, we conclude that the prescribed fire program may affect, but is not likely to adversely affect humpback chub critical habitat.

### POTENTIAL FOR CUMULATIVE EFFECTS OF NON-FEDERAL ACTIONS TO HUMPBACK CHUB

We are aware of no non-federal actions that would cause cumulative effects to humpback chub critical habitat.

# IX. SOUTHWESTERN WILLOW FLYCATCHER

## BACKGROUND

On March 29, 1995, the southwestern willow flycatcher (*Empidonax traillii extimus*) was designated as endangered in its entire range, which is known to include Arizona, California, Colorado, New Mexico, Texas, Utah, and Mexico. The southwestern willow flycatcher is a small bird, approximately 15 centimeters (cm) (5.75 inches) long. It has a grayish-green back and wings, whitish throat, light grey-olive breast, and pale yellowish belly. Two wingbars are visible; the eye ring is faint or absent. The upper mandible is dark, the lower is light. The song is a sneezy ''fitz-bew'' or ''fit-za-bew,'' the call a repeated ''whitt.'' The southwestern willow flycatcher occurs in riparian habitats along rivers, streams, or other wetlands, where dense growths of willows (*Salix* sp.), *Baccharis* sp., arrowweed (*Pluchea* sp.), buttonbush (*Cephalanthus* sp.), tamarisk (*Tamarix* sp.), Russian olive (*Eleagnus* sp.) or other plants are present, often with a scattered overstory of cottonwood (*Populus* sp.) (U.S. Fish and Wildlife Service 1995b). Throughout the range of *E. t. extimus*, these riparian habitats tend to be rare, widely separated, small and/or linear locales, separated by vast expanses of arid lands.
The southwestern willow flycatcher has experienced extensive loss and modification of this habitat and is also endangered by other factors, including brood parasitism by the brown-headed cowbird (*Molothrus ater*) (U.S. Fish and Wildlife Service 1995b).

## SOUTHWESTERN WILLOW FLYCATCHER SURVEYS IN GRAND CANYON NATIONAL PARK

In both 2001 and 2002 Grand Canyon Monitoring and Research Center crews located a single pair of southwestern willow flycatchers between river mile 50.5 and 51.5. All other sites were negative. In 2000 four adults were observed at river mile 246.

## CONSERVATION MEASURES FOR THE SOUTHWESTERN WILLOW FLYCATCHER AND ITS HABITAT

- The park will adhere to the air quality standards set by the Arizona Department of Environmental Quality.

## EFFECTS OF THE PROPOSED ACTION ON THE SOUTHWESTERN WILLOW FLYCATCHER AND ITS HABITAT

The southwestern willow flycatcher known locations are far enough removed from the project areas that the only potential effect from fire is smoke. Nightly weather conditions may draw smoke from the rim down into the river corridor near river mile 52. However, this event would be limited to burns within the Uncle Jim project area. Currently we have planned a 500 acre burn in 2006 and 2008 in this project area. It is anticipated that smoke impacts would be lessened as the burns will be distant (9.5 linear miles) from

the known inhabited location and typical weather conditions would lift smoke out of the canyon daily in the early afternoon. In addition smoke monitors will be present for the duration of the fire and every effort will be made to prevent smoke levels from violating the Arizona Department of Environmental Quality standards. As any smoke effects would likely be of short duration, and as the birds are found quite distant from the plateau, we believe that any potential effects would be insignificant. Therefore, we conclude these prescribed fire projects may affect, but are unlikely to adversely affect southwestern willow flycatchers.

### POTENTIAL FOR CUMULATIVE EFFECTS OF NON-FEDERAL ACTIONS TO THE SOUTHWESTERN WILLOW FLYCATCHER

We are aware of no non-federal actions that would cause cumulative effects to the southwestern willow flycatcher or its habitat.

# X. BALD EAGLE

## BACKGROUND

The bald eagle is the only eagle unique to North America. It ranges over most of the continent, living near rivers, lakes, marshes and other wetlands. Males weigh 7 to 10 pounds and have a wingspan of over 6 feet; females weigh up to 14 pounds and have a wingspan of up to 8 feet. Bald eagles commonly eat fish, but will also eat ducks, rodents, snakes, and carrion (U.S. Fish and Wildlife Service 1995a).

Bald eagles have received some type of legal protection in the U.S. since 1940 in an attempt to protect them from various threats, including habitat loss, illegal shooting, and DDT contamination. Recovery efforts have been successful. In 1995, the species' status in the lower 48 states was changed from endangered to threatened (U.S. Fish and Wildlife Service 1995a).

## BALD EAGLE SURVEYS IN GRAND CANYON NATIONAL PARK

Bald eagles are known to occur in the park during the winter. Four sites have been identified within the park as winter roost areas: Nankoweap Creek near its confluence with the Colorado River, Bright Angel Creek near Phantom Ranch, Twin Overlooks, and Pasture Wash (see Appendix H).

Bald eagle concentrations were first noted by river guides in the Nankoweap creek area in the early 1980's. The cause of the concentration was attributed to an increase in the rainbow trout (*Oncorhyncus mykiss*) population following the creation of the Glen Canyon Dam (Brown et al. 1989). From 1989-94 wintering bald eagles were present from late fall (October-November) through early spring (March-April), with peak numbers occurring in January and February. The highest known bald eagle concentration at Nankoweap Creek occurred in 1990 with about 70-100 individuals documented between 8 February to 8 March. The highest recorded number of bald eagles concentrated at Nankoweap Creek during a given day was 26 in late February 1991 (DOI 1995).

While the bald eagle concentration at Nankoweap may have been the largest concentration in the southwestern United States (DOI 1995), recent records indicate that this concentration has largely disbanded. While the Park has not been able to maintain a steady monitoring effort, recent reports of bald eagles in the Nankoweap area have been primarily individuals and pair sightings (Elaine Leslie and Chad Olson, GRCA Wildlife Biologists, personal communication, 2003). This decrease in numbers has been attributed to a modification to the fish spawning habitat following flash floods through the Nankoweap drainage.

Bald eagle sightings at Bright Angel Creek, Twin Overlooks, and Pasture Wash have been limited to a single bird (Elaine Leslie and Chad Olson, GRCA Wildlife Biologists, personal communication, 2003).

**CONSERVATION MEASURES FOR THE BALD EAGLE AND ITS HABITAT**

- The park will adhere to the air quality standards set by the Arizona Department of Environmental Quality.
- A 1000 foot no-flight perimeter will be established around the observed roost locations at Twin Overlooks from October 1 to April 1.

**EFFECTS OF THE PROPOSED ACTION ON THE BALD EAGLE AND ITS HABITAT**

As prescribed fires may burn into October or November, and may be ignited as early as March, the potential exists for bald eagles to be affected by smoke. However, fires will not be ignited in January or February when bald eagle concentrations have historically peaked. Further, ignition periods for this project will only occur on good smoke dispersion days and will typically be completed within a single day but may extend to two days. Aerial ignition, the primary ignition method used for these projects, results in short duration burns in which the majority of fuels are burned within a 24-hour period from the time of ignition.

Nightly weather conditions may draw smoke from the rim down into the river corridor near the Nankoweap and Bright Angel Creek populations. However, we believe these populations are far enough removed from these projects that any effects would be insignificant. Therefore, we conclude that these projects may affect, but would not likely adversely affect bald eagles at these two sites.

The Shoshone and Long Jim III burn units are within 0.5 miles of the Twin Overlooks bald eagle roost location. These burn units may be ignited during March – April or after October. Therefore, we conclude that these projects may affect bald eagles at this site.

**POTENTIAL FOR CUMULATIVE EFFECTS OF NON-FEDERAL ACTIONS TO THE BALD EAGLE**

We are aware of no non-federal actions that would cause cumulative effects to the bald eagle or its habitat.

# XI. DESERT TORTOISE

## BACKGROUND

On August 20, 1980, the Service listed the Beaver Dam Slope population of the desert tortoise (Gopherus agassizii), in southwestern Utah, as a threatened species and designated 35 square miles of critical habitat. On September 14, 1984, the Service received a petition from the Environmental Defense Fund, Natural Resources Defense Council, and Defenders of Wildlife to list the desert tortoise in Arizona, California, and Nevada as endangered. In September 1985, the Service determined that the listing was warranted but precluded by other listing actions of higher priority under authority of section 4(b)(3)(iii) of the Act. The Service made annual findings of warranted but precluded from 1985 through 1989 under section 4(b)(3)(C) of the Act. On May 31, 1989, the same three environmental organizations provided substantial new information and petitioned the Service to list the desert tortoise as endangered throughout its range in the United States under the expedited emergency provisions of the Act. As a result of the new information, on August 4, 1989, the Service listed the Mojave population, excluding the Beaver Dam Slope population in Utah, as endangered by emergency rule. The Mojave population was designated in the emergency rule as all tortoises occurring north and west of the Colorado River, in California, Nevada, Arizona, and Utah. The Mojave population was then proposed under normal listing procedures on October 13, 1989, and listed as threatened on April 2, 1990 (U.S. Fish and Wildlife Service 1994c).

The Mojave population of the desert tortoise occurs primarily on flats and bajadas characterized by scattered shrubs and abundant inter-space for growth of herbaceous plants, with soils ranging from sand to sandy-gravel. Desert tortoises are also found on rocky terrain and slopes, and there is significant geographic variation in the way desert tortoises use available resources. The Mojave population was listed because desert tortoise numbers are declining precipitously in many areas. These declines are mainly attributed to direct and indirect human-caused mortality coupled with the inadequacy of existing regulatory mechanisms to protect desert tortoises and their habitat. Impacts such as the destruction, degradation, and fragmentation of desert tortoise habitat result from urbanization, agricultural development, livestock grazing, mining, and roads. Human “predation” is also a major factor in the decline of desert tortoise populations. Predation is used here in its broadest sense, meaning the taking of desert tortoises out of their populations either by death (accidental or intentional) or removal from native habitat. An upper respiratory tract disease (URTD) is an additional major cause of desert tortoise mortality and population decline, particularly in the western Mojave Desert (U.S. Fish and Wildlife Service 1994a).

**SURVEYS FOR DESERT TORTOISE IN GRAND CANYON NATIONAL PARK**

We are currently assembling survey information and will forward that information as it becomes available, however no suitable habitat occurs in or near the project area.

**CONSERVATION MEASURES FOR DESERT TORTOISE AND ITS HABITAT**

- No conservation measures are necessary, as no prescribed fire activities or effects from these projects will be occurring in or near desert tortoise habitat.

**EFFECTS OF THE PROPOSED ACTION ON DESERT TORTOISE AND ITS HABITAT**

The prescribed fire program will not include any desert tortoise habitat nor have the possibility of reaching any desert tortoise habitat. It is our conclusion that these prescribed fires will have no effect on the desert tortoise

**POTENTIAL FOR CUMULATIVE EFFECTS OF NON-FEDERAL ACTIONS TO DESERT TORTOISE OR ITS HABITAT.**

We are aware of no non-federal actions that would cause cumulative effects to the desert tortoise or its habitat.

# XII. MEXICAN SPOTTED OWL

## BACKGROUND

The Mexican spotted owl (*Strix occidentalis lucida*) is one of three subspecies of spotted owl occurring in the United States; the other two are the northern spotted owl (*S. o. caurina*) and the California spotted owl (*S. o. occidentalis*). The Mexican spotted owl is distinguished from the California and northern subspecies chiefly by geographic distribution and plumage. The Mexican spotted owl is mottled in appearance with irregular white and brown spots on its abdomen, back, and head. The spots of the Mexican spotted owl are larger and more numerous than in the other two subspecies, giving it a lighter appearance (U.S. Fish and Wildlife Service 2001).

Mexican spotted owls (*S. o. lucida*), found on forested plateaus and canyonlands throughout the Southwest United States and Mexico, have been thought to be dependent on late seral forests (Ganey and Balda 1989a, Gutierrez et al. 1995). The Mexican spotted owl is generally restricted to isolated patches of habitat that include mixed conifer and pine-oak forests, riparian madrean woodland, and sandstone canyonlands (U.S. Fish and Wildlife Service 1995d). Zwank et al. (1994) reported that Mexican spotted owls were common in mature forests in New Mexico. Ganey and Balda (1989a, 1989b, and 1994) demonstrated that Mexican spotted owls were most common in mixed conifer and pine forests in Arizona south of the Grand Canyon, although they reported several sites where the owl was found breeding in rocky canyon habitat with scattered stands of forest vegetation.

Although typically associated with mature forest habitat, Rinkevich (1991) and Willey (1995) confirmed the presence of Mexican spotted owls within arid canyonlands scattered across southern Utah and northern Arizona. In these locations, the owl was associated with steep sandstone canyons that included relatively open Great Basin Desert scrub and Great Basin conifer woodland vegetation communities (Brown 1982). The canyonland breeding habitat has been described as “aberrant” considering the late seral forest habitat requirements reported for the owl in the literature (Gould 1977; Forsman et al. 1984; Zwank et al. 1994; Seamans and Gutierrez 1995; Miller et al. 1997). Rinkevich and Gutierrez (1996) and Willey (1995) found 21 spotted owl pairs associated with relatively dry and open canyon topography with small patches of forest vegetation in Zion National Park. Willey (1995) described the distribution of the owl in the Utah canyon country and suggested that the owl was not dependent on mature forest vegetation as previously believed (e.g., Gutierrez et al. 1995).

The Mexican spotted owl was listed as threatened on March 16$^{th}$, 1993, and the final rule designating critical habitat was published on February 1$^{st}$, 2001. Two primary reasons were cited for listing the owl as threatened. The first was historical alteration of habitat as the result of timber management

practices, specifically the use of even-aged silviculture, and the threat of these practices continuing. The second was the danger of catastrophic wildfire (U.S. Fish and Wildlife Service 2001).

## MEXICAN SPOTTED OWL SURVEYS AT GRAND CANYON NATIONAL PARK

Mexican spotted owls have been reported in numerous visitor accounts for Grand Canyon National Park since the 1920s (unpublished park wildlife records, Natural Resources Office). Willey (1992) formally confirmed the presence of spotted owls within Grand Canyon National Park during field surveys conducted on the North and South Rims. These initial surveys encompassed approximately 6,000 acres of suitable habitat and used the formal U. S. Forest Service protocol in existence at the time (USDA 1991). Willey's (1992) few responses were from within the canyon itself rather than the plateau areas. In 1994 and 1995, the most suitable South Rim plateau habitat was surveyed with negative results (Kuenzi unpub., Kaibab National Forest Wildlife files).

In 1998 and 1999, a large-scale survey was undertaken on the North Rim (Willey 1998 and 1999). These surveys covered all suitable owl habitat on the heavily forested North Rim plateau area, including the Walhalla Plateau, and used the formal U.S. Fish and Wildlife Service survey protocol (USDI 1995). No responses were elicited from owls during these surveys.

Additional surveys were conducted in 1999 by Willey in side canyon habitat with access achieved through the Colorado River corridor. These surveys located two pairs and four single male MSO's in side canyon habitat.

In 2001 and 2002, a large-scale river-based inventory was undertaken with the result of approximately 53 additional side-canyon dwelling owls located (Willey et al, 2001a; unpublished GRCA Wildlife Records, 2002). Surveys were also conducted along a 30-mile stretch of South Rim Plateau habitat, and in the Cape Royal and Point Imperial areas. These surveys resulted in the location of several owl territories within side canyon habitat (Willey et al 2001b). The Walhalla and Outlet Plateaus were surveyed in 2001 with negative results. In 2002, a pair of owls was located from a rim calling station near the Bright Angel peninsula.

Taken together, the owl locations in the park suggest that the owl occupies the rugged canyonland terrain within the Grand Canyon rather than more classical late seral forest habitats on the North and South Rims.

The above mentioned inventory efforts have shown that a relatively large spotted owl subpopulation exists in the Grand Canyon National Park. The status and management of these owls is therefore highly relevant to the species overall conservation and demographic health. This population may

represent a potentially large source population for the Southwest as a whole (Shaffer 1985).

**CONSERVATION MEASURES FOR THE MEXICAN SPOTTED OWL**

- Park wildlife biologists will be consulted early in the decision-making process for prescribed fires.
- To minimize negative effects on habitat, fires will be managed as low-intensity fires, as discussed in the project description.
- The park will adhere to the air quality standards set by the Arizona Department of Environmental Quality.
- If fireline construction is necessary, we will minimize the cutting of trees and snags larger than 18" DBH, and no trees or snags larger than 24" DBH will be cut unless absolutely necessary for safety reasons.
- If fireline construction is necessary, we will rehabilitate the line after use. This will be done by pulling soil, duff, litter, woody debris, and rocks back onto the line to bring it up to grade and to make it blend in with the surrounding area.
- To the maximum extent possible, aircraft will remain at least 1000 feet from the boundary of any designated Protected Activity Center.
- If Mexican spotted owls are discovered during project activities, a park wildlife biologist will be notified immediately.
- Firefighters will not approach or haze Mexican spotted owls, if found.
- We will survey known PACs that can be surveyed from the rim, and that are adjacent to project areas prior to project implementation.
- We will survey all Mexican spotted owl habitat that is within 0.5 miles of project perimeters prior to project implementation in accordance with the Formal Mexican Spotted Owl Survey Protocol (DOI 2003).
- Efforts to locate spotted owl nest sites will be made prior to project implementation so that potential affects can be better monitored.

**EFFECTS OF THE PROPOSED ACTION ON THE MEXICAN SPOTTED OWL**

The areas identified for these prescribed fires include 13,172 acres of mixed conifer habitat that has been identified as restricted MSO habitat. In addition, approximately 7,632 acres of protected habitat exists in the form of 9 PAC's which may receive indirect effects from smoke and/or noise. Eight of these 9 PAC's, representing about 6,948 acres, have the potential to receive direct effects from fire. Additionally, there are thousands of acres of steep slope protected and canyon critical habitat bordering many of these projects, of which 2,500 acres may be affected.

During project activities, possibilities exist for direct injury or disturbance to owls from fire, smoke, increased levels of noise and activity, aerial application of water or retardant, and collision with aircraft. Indirect harm could occur through damage to habitat. Each of these factors is discussed

below, as are the conservation measures that are intended to minimize the possibility of harm.

### *Fire*

As previously discussed, the prescribed fires will be managed as a low intensity ground fires, with occasional patches of moderate and high intensity fire.

Lehman and Allendorf (1989) and Smith (2000) note the low fire-caused wildlife mortality figures from several studies and conclude that low intensity wildfires usually do not kill animals, as most are able to hide or escape. Given that the majority of the forested plateaus within the park have been surveyed over multiple seasons resulting in almost exclusively negative data, it is unlikely that spotted owls are using these areas for nesting. If owls are foraging within the project perimeter the fire could cause a temporary shift in foraging behavior. Willey (1998b) used radio telemetry to study the effects of prescribed fire on spotted owls in Saguaro National Park's Rincon Mountains. Several spotted owls continued to forage after low intensity ground fires within Ponderosa pine stands, although a temporary shift from the historic roosting location was noted during the fire activities. Willey identified no significant influence of fire on home range size or shape. With the information gathered from past survey efforts as well as that provided by Willey, we feel that the overall probability of fire directly harming owls is low.

### *Noise and visual disturbance*

The activities associated with managing a prescribed fire involve igniting and monitoring the fire's progress. After monitoring weather conditions and insuring that proper fuel moisture and wind patterns exist, firefighters will ignite the perimeter of the project area using standard hand ignition practices. The perimeter will be divided into sections and lit in a controlled manner. Once a defensible perimeter is established the interior of the project area will be lit by aerial ignition. Large patches of unburned areas within the perimeter may be re-ignited using drip torches or other hand ignition techniques. While the fire is burning, small numbers of fire monitors will patrol the area recording the fires growth and behavior.

In some cases, it also becomes necessary to use suppression techniques to manage the fire. These can range from small efforts such as putting in a fireline around a cultural resource site to suppressing one flank of a fire while allowing the other to grow. It is also possible that the fire could exceed the prescription and cease to be a low intensity ground fire, or could threaten the pre-established project boundaries, in which case, full scale suppression activities will be undertaken. These activities would result in increased levels of disturbance from personnel on the ground and from aircraft.

Should the fire drop over the rim and enter into a PAC, the presence of firefighters above occupied Mexican spotted owl habitat and the potential suppression actions within this habitat could induce behavioral changes, but the extent of this impact is largely unknown. No study directly analyzes suppression activities, but Swarthout and Steidl (2001) examined the effects of backcountry recreation on Mexican spotted owls in Utah. They observed that, with the approach of a hiker, juveniles and adults were unlikely to flush at distances >12m and >24m, respectively, and neither age-class was likely to alter their response at all when hikers were at distances >55m. The presence of small fire crews rather than a single hiker would no doubt increase flush response, but to what degree is unknown. Aside from flush response, Swarthout and Steidl (2001) examined other behavioral traits and noted that activity budgets did not change markedly when hikers passed near nests every 15 minutes. During the disturbance periods, females decreased the amount of time they handled prey by 57% and increased contact vocalizations by 58%, but were otherwise unaffected.

Relatively few studies have been made on the response of animals to noise and visual stimuli produced by aircraft. These studies have been supplemented with incidental observations, but there still remains a dearth of information on the subject. Reported animal responses vary greatly among species, and the ability of species to adapt to overflights also varies. In general, the long-term effects of aircraft overflights are unclear. The potential consequences from noise are thought to be greatest on breeding animals (USDI 1995b). The majority of studies on wildlife responses to overflights suggest that responses appear to be temporary and do not result in long-term effects to animal population numbers or habitat use. However, few of these studies provide empirical data on long-term impacts of chronic noise exposure. The few studies available that evaluate measures of reproductive success (e.g., return to nest sites, fledgling body weights and number of young raised) were conducted over only a one or two year period. Therefore, the long-term effects of very frequent overflights need to be studied on this and other raptor species before definitive conclusions can be formulated.

Animal responses reported in the literature have been either physiological or behavioral in nature (Knight and Gutzweiller, 1995). Physiological effects may include temporary or permanent hearing threshold shifts, masking of auditory signals, increased respiration and heart rate, and increased corticosteroid levels. Reported hearing threshold shifts were related to noise sources that were of much greater duration (minutes and hours) than a typical aircraft overflight in Grand Canyon, which generally lasts from a few seconds to a minute. Behavioral responses may include animals becoming alert and turning toward the sound source, fleeing from the sound source, changes in activity patterns (e.g., interrupted feeding), nest abandonment, or changes in habitat use. If the changes are sufficiently severe, the health and survival of an individual animal may be reduced. If a large number of animals are affected, then population declines could result.

A limited number of studies have evaluated the effects of human-induced disturbance and noise on raptors. Predictably, raptor responses to noise and disturbance in these studies have varied. Most studies reported relatively minor impacts and many of these found effects to be temporary (e.g., Lamp, 1987). In the few cases where reproductive success was evaluated, reproductive parameters were sometimes affected, but not to a large degree. The studies discussed below evaluated noise sources from ground-based activities as well as aircraft. Frazer et al. (1985) and Grubb and King (1991) reported that nesting raptors were more sensitive to ground-based activities compared to aircraft. Grubb and King (1991) also reported that animals show a greater response to helicopters than to fixed-wing aircraft. In certain studies discussed below, the general findings of research on ground-based noise are also provided to further show the general responses of raptors to noise.

Grubb and King (1991) evaluated nesting bald eagles and reported that eagles reacted more strongly to pedestrians and helicopters than to fixed-wing military jet aircraft. Eagles responded to aircraft 75% of the time when overflights were about 300 feet from the nests. They suggested that the severity of response was related to a variety of factors including distance (most important), duration, visibility, number, position, and noise level. They did note that response to aircraft did not linearly increase as distance decreased. Frazer et al. (1985) evaluated responses of bald eagles in Minnesota to overflights. Based on over 850 overflights of fixed-wing aircraft, only two eagles flushed from nests, but 10% of birds flushed from perches.

Holthuijzen et al. (1990) studied the response of four nesting pairs of prairie falcons to construction blasting and four nesting pairs to experimental blasting in southwest Idaho. They reported that incubating and brooding falcons flushed about 22% of the time but on average returned to the nest within 3.4 minutes and resumed activities within an additional 2.5 minutes. Two of the four pairs exposed to construction blasting fledged young, while all four pairs exposed to experimental blasting fledged young. Three of four nests in the construction blasting area were not reoccupied the following year, whereas all nests were reoccupied in the experimental blasting area. The authors suggested that activities not be conducted closer than about 140 feet when peak noise levels were 140 dB or less. In addition, they suggested that no more than three blasts a day occur.

Anderson et al. (1990) evaluated the responses of red-tailed hawks, Swainson's hawks, ferruginous hawks, and golden eagles to ground-based military training activities occurring in August in southeastern Colorado. The authors reported that home range size generally increased during military training. They also noted that one of two ferruginous hawks and the Swainson's hawk left the area and did not return until the following spring. The authors speculated that the changes in home range may increase energy

needed by the birds and reduce reproductive success if training occurs during the nesting season.

A few studies have evaluated raptor responses to helicopters. Ritchie (1987) reported that peregrine falcon responses varied from no response to flushing when helicopters were within 2,000 feet of the birds. Craig and Craig (1984) reported that prairie falcons, red-tailed hawks, and golden eagles exhibited varied responses when helicopters passed nearby. Individual bird responses ranged from absolutely no response to abandonment of perches as helicopters approached. In a study of red-tailed hawk response to helicopters, Anderson et al. (1989) reported that birds would flush from their nests but that the overflights did not appear to affect rearing of young. In an earlier study, Anderson et al. (1982) found that experienced birds appeared to become more tolerant to aircraft. This is contrary to research results reported for waterfowl (Black et al. 1984, Ward and Stehn 1989). White and Sherrod (1973) reported that nesting raptors flushed from nests when overflown by helicopters that approached unseen. These authors, as well as others, suggest that raptors may be more likely to flush if the noise or sight of the aircraft is sudden and in close range to the nests.
Marzluff et al. (1994) concluded that Army National Guard training within the Snake River Birds of Prey National Conservation Area was correlated with increased foraging distances and temporary training area avoidance in prairie falcons. It is probable that increases in foraging distances may result in stress to birds by increasing the energetic costs of foraging.

Contrary to the somewhat negative reports described above, other researchers have concluded that exposure to fixed-wing aircraft did not negatively affect raptor species. Poole (1989) reported that ospreys rarely left the nest when exposed to fixed-wing aircraft. Similarly, White and Thurow (1985) reported that ferruginous hawks did not respond to fixed-wing aircraft within 100 feet of their nests. Most authors, however, note that their studies deal with low frequency overflights and caution that frequent low altitude flights could reduce nesting success.

In a study involving peregrine falcons and military aircraft (Ellis 1981), birds were observed during more than 1,000 overflights with noise levels of 82 to 114 A-weighted decibels (dBA). Responses usually included abandoning current behavior and watching the aircraft, but alarm behavior occurred when aircraft were between 500 feet (nearest reported distance) and 1,600 feet above ground level. Birds did not respond appreciably to aircraft beyond 1,640 feet. When responses did occur with aircraft passing at closer distances, the responses were temporary and did not result in reproductive failures. Ellis also collected limited physiological data on prairie falcons, concluding that elevated heart rates caused by aircraft overflights were temporary and within the normal response parameters of this species.

In a follow-up study, Ellis et al. (1991) evaluated the effects of low-level military aircraft flights on 18 peregrine falcon nest sites and nearly 40

breeding attempts of several other raptor species, including prairie falcons. Response of raptors was observed for more than 1,000 overflights that ranged from 220 feet to 1,500 feet from nests and generally resulted in Sound Exposure Levels (SEL) greater than 90 dBA. (SEL is a single event composite measure that takes into account the maximum noise level associated with a noise event and the duration of the event). Of the 1,000-plus flights, 482 were within 500 feet of nests. Of the 482 passes within 500 feet, 52 (4%) resulted in cowering or flight responses. The remaining 430 flights (96%) resulted in birds temporarily stopping activities, orientating and observing the aircraft, or exhibiting no response. In addition, the authors noted that all responses to aircraft were temporary and minor. Fledgling success for all raptor nests observed was 89% (34 of 38 nests) and peregrine falcon fledgling success was similar to general state trends. Similarly, 21 of the 22 peregrine falcon nests used for observations during the study were occupied the following year, with 19 positively identified as active nests. The authors did state that extrapolation of the results estimating long- term productivity impacts was not feasible.

Enderson and Craig (1994a & 1994b) and Enderson (1996) evaluated the effects of aircraft overflight on peregrine falcons near Colorado Springs and the Fort Carson Airburst Gunnery Range. Five adult birds were fitted with telemetry and movements were monitored in 1994. Observational information was generated regarding movements (Enderson and Craig 1994b) and response to overflights. Home ranges averaged about 350 square miles and overlapped. Adults hunted up to 32 miles from nest sites (Enderson 1996). Enderson concluded that military operations did not affect the ordinary outcomes of nesting behavior. He speculated that this was due to the fact that peregrines normally live in very noisy environments where they were stimulated on a daily basis by thunderstorm activity near their nest sites.

Studies that specifically address effects of aircraft noise and visual stimuli on Mexican spotted owls are limited. Delaney et al. (1999) studied the effects of helicopter noise and chain saws on Mexican spotted owls in the Lincoln National Forest. They compared noise stimulated plots and control plots and found that “manipulated and non-manipulated nest sites did not differ in reproductive success (P = 0.59) or the number of young fledged (P = 0.12).” They recommend 105-m buffer zones around nest sites for helicopter overflights. Johnson and Reynolds (2002) studied the responses of Mexican spotted owls to low-flying military jet aircraft. In several trials, they found that the owls’ responses to the overflights ranged from no response (no body movements) to an intermediate response (sudden turning of the head). These responses did not exceed the range of behaviors exhibited before and after the overflights.

The Mexican spotted owl’s seemingly preferred habitat of steep canyons below the rim in Grand Canyon suggest that aircraft overflights will often be obscured from owls, but that the high canyon walls may also amplify the

stimuli and repeat it through echoes. Given that aircraft pass over the rims of Grand Canyon at elevations of 300 feet, the potential does exist for disturbance to owls, especially if they are using the upper reaches of side canyons, or if they are using habitat above the rim.

As a conservation measure to minimize the potential for disturbance, aircraft involved in fire management activities will not approach within 1000 feet (approx. 300 m) of PAC perimeters to the maximum extent possible.

### *Collisions with Aircraft*

Bird strikes occur with significantly greater frequency than is generally imagined. Conover et al. (1995) compiled reported statistics and estimated that annual losses in the United States totaled $200 million to civilian aircraft, $45 million to military aircraft, and seven fatalities. Bird strike data are difficult to accumulate and analyze given the fact the only sources of these data are voluntary pilot reports (FAA form 5200-7). It has been estimated that only 20 to 30% of all bird strikes are reported by pilots (Burger 1985; Conover et al. 1995). Collisions between owls and aircraft have been documented for a variety of species (Krivitski 1991; Linnell et al. 1996; Garber 1998). Linnell et al. determined that of the 526 bird strikes that occurred between 1990 and 1994 at Lihue (Hawaii) Airport, 43 (8.2 %) involved barn owls (*Tyto alba*) and 23 or 4.4% involved short-ear owls (*Asio flammeus*).

No data are available documenting the number of collisions between birds and aircraft that occur over Grand Canyon National Park or at Grand Canyon Airport. Given the extremely low population number of Mexican spotted owls in the area and the fact that overflights occur during the day when owls are least active, the possibility is decidedly remote that a collision will occur.

### *Smoke*

The park is a Mandatory Federal Class I area for air quality under the Clean Air Act, making the park, and fire management, subject to stringent air quality standards set by the Arizona Department of Environmental Quality (ADEQ). Amounts of smoke which would be associated with a violation of the ADEQ standards would also be likely to pose risks for visitors, and by extension, to wildlife. Because such a violation would be a serious problem for the park, every effort is made to avoid this during any prescribed fire operation. First, ignitions are only conducted when weather forecasts and current conditions indicate that smoke will be carried up and away from the canyon on the prevailing southwest winds. Second, various methods of air quality monitoring (dataRAM particulate monitors, transmissometers, photo points) are employed at several locations in Grand Canyon during such operations. The data collected is analyzed on a continuous basis and the results are passed on to fire managers and to ADEQ. If an impending violation is detected, fire managers will adjust management strategies to

reduce smoke production and avoid the violation. These measures will limit the potential for negative effects to the owl from smoke.

There is a lack of scientific literature detailing what effects smoke may have on the Mexican spotted owl or other raptor species. Given that Mexican spotted owls have co-evolved with fire-adapted ecosystems in the southwest, they are no doubt tolerant of a certain amount of smoke, but no data are available to determine what this level of tolerance might be. As with other fire effects, young, less mobile owls would be more likely to be negatively affected than adults which could more easily move away from smoke.

Until we have more information on how smoke affects owls, we will have to rely on the park's adherence to the ADEQ air quality standards to minimize any negative effects. While the possibility certainly exists for some effect to owls, it is reasonable to expect that the ADEQ standards will serve to protect owls from extensive exposure to heavy smoke.

***Damage to habitat***

The Mexican spotted owl Recovery Plan is supportive of the use of fire as a treatment to reduce the risk of catastrophic wildfire in owl habitat. The plan acknowledges that:

> *The risk of catastrophic fires is widespread in Southwestern forests and woodlands. Fuel accumulations and forests overstocked with trees place spotted owl habitat at risk with respect to stand-replacing fires.* (Recovery Plan, p. 60)

It also states that:

> *Given the present conditions of Southwestern forests, extreme fire years could result in holocaustic fires throughout large portions of the owl's range. Because the resulting damage to owl habitat would be irreparable in the foreseeable future, efforts to limit large-scale catastrophic fires are of the utmost importance for owl conservation.*
>
> *Increased use of fire and other tools will be needed to reduce the amount of forest at high risk from stand-replacing fires. The Recovery Team encourages proactive fire management programs which assume active roles in fuels management and understanding the ecological role of fire.* (Recovery Plan, p. 61)

The Recovery Plan divides Mexican spotted owl habitat into protected habitat, restricted habitat, and other forest and woodland habitat. Protected habitat includes a minimum area of 600 acres (243 ha) deemed as Protected Activity Centers [PACs] which are designated around known nest or roost sites. It also includes >40% slopes in mixed-conifer or pine-oak habitat which have not been harvested in the last 20 years. Protected habitat areas receive the

highest level of protection, and the Recovery Plan offers very specific guidelines for the management of these areas. Restricted habitat areas include pine-oak, mixed-conifer, and riparian forests, and these areas receive the next highest level of protection. The Recovery Plan presents target/threshold guidelines for development or maintenance of nesting and roosting habitat within these areas. Other forest and woodland habitat areas include pure ponderosa pine forest, spruce-fir forest, aspen groves, and pinyon-juniper woodland. These areas receive the least protection and no specific guidelines are offered for management of these areas.

*Protected Areas – Protected Activity Centers*

There are 9 PAC's within proximity of planned projects. Eight of these PAC's are close enough to the rim that fire has the possibility of entering into them should fire fall to the 6,000-foot level. While prescribed fire projects are not targeted at areas below the rim, it is desirable to draw the project boundary to include areas over the rim and down to approximately the Coconino sandstone layer (6,000 feet), where a natural firebreak commonly occurs. Setting the project boundary at the rim creates an artificial, and much less defensible, boundary. Holding a fire at the rim often requires extensive use of a helicopter to drop water. This is a problem, as it is a hazardous operation which greatly increases the overall risk associated with the project. Such operations will also cause additional disturbance to wildlife in the area. As part of these project plans we will not allow fire into more than 1,200 acres of habitat within PAC's. If exceeding this limit seems likely then suppression actions will be initiated. However, for the reasons stated above this outcome is undesirable. For that reason we would like to re-initiate consultation should more than 700 acres of within PAC habitat burn. The 500 acre buffer between these two limits should prevent a single event from pushing us to our maximum limit.

*Protected Areas – Mixed-Conifer Steep Slopes and Canyon Critical Habitat*

It is not the Park's intent to burn acres below the rim within steep slope protected habitat or canyon critical habitat and this would only occur as a result of an unforeseen event. In evaluating past prescribed fires this event has occurred infrequently and to a limited extent. Should this event occur the Park's land managers will weigh the potential positive and negative effects associated with allowing the fire to burn or suppressing the fire to determine the appropriate action. As such, we have set an arbitrary limit of 2,500 acres of below-rim habitat that we will allow to burn as part of these prescribed fires. If fire looks likely to exceed 2,500 acres of below-rim habitat suppression actions will be initiated to make every effort not to exceed this limit, without compromising human safety. However, the use of suppression tactics is undesirable for both human safety and biological reasons. As such, we would like to re-initiate consultation with FWS should we burn more than 1,000 acres of below-rim habitat to avoid having to result to suppression actions. The 1,500 acre buffer between these two limits should prevent a single event from pushing us to our maximum limit.

*Restricted Areas*

There is approximately 13,172 acres of mixed conifer restricted habitat within the project perimeters. The key habitat components that make mixed-conifer restricted habitat important to owls include hardwoods, a multi-storied canopy, high tree basal area, high canopy cover, large down logs, large trees, and snags. All of these components are also primary constituent elements of critical habitat for Mexican spotted owls. Because all of the protected and restricted habitat in the park is also critical habitat, we will avoid repetition by discussing the specific effects of the prescribed fires on these habitat components in the Mexican spotted owl critical habitat section which follows.

The Recovery Plan provides target/threshold conditions (U.S. Fish and Wildlife Service 1995d, Table III.B.1, p. 92) as guidelines for maintenance and development of the key habitat components in appropriate amounts across the landscape. The plan states:

> *We used tree basal area, large tree (>45.7cm[18in] dbh) density, and tree size-class distribution as the variables to define target/threshold conditions (Table III.B.1). Other variables such as snags and downed logs are important as well. We assume that if the basal area and tree density levels given in Table III.B.1 exist, adequate amounts of snags and downed logs (and other habitat elements) should be present.* (U.S. Fish and Wildlife Service 1995d, p. 91)

The target/threshold conditions for mixed-conifer in the Colorado Plateau recovery unit are as follows:

- In 25% of the planning area, 10% of the stand density of trees should occur in each of the 12-18" DBH (diameter at breast height), 18-24" DBH, and 24"+ DBH size classes.
- In 25% of the planning area, total tree basal area should be 32 $m^2$/hectare (150 $ft^2$/acre), and density of trees >18" DBH should be 49 trees/hectare (20 trees/acre).
- In a subset of the 25% portion of the planning area, 10% of the planning area should have the same stand density distribution as described above, should have a total tree basal area of 39 $m^2$/hectare (170 $ft^2$/acre), and should also have a density of trees >18" DBH of 49 trees/hectare (20 trees/acre).

The park's fire effects monitoring program, although not designed to provide data to address the target/threshold conditions, can provide information on the nature of mixed-conifer habitat in the park. The program has also recently had the opportunity to collect data on stand conditions before and after wildland fire use and prescribed fires in mixed-conifer habitat on the North rim of the Grand Canyon. In order to achieve a sufficient sample size, both fire use fires and prescribed fires were analyzed together. We felt that as both types of fires burn, overall, at a low intensity that this would offer

the best representation of what might be expected from prescribed fires in the mixed-conifer habitat within these projects. In general, fire use fires burn hotter than prescribed fires. By combining these two types of fires for our analysis we present what we expect to be the worst case scenario for prescribed fires. Some of this fire effects data was also supplemented with remotely-sensed and ground-truthed burn severity data. Although we have a relatively small sample, these data provide some idea of what effects we can expect from primarily low intensity fires relative to target/threshold conditions.

Mixed-conifer is one of the vegetation types that the fire effects monitoring program uses to stratify plots. We define the type as follows:

> *PHYSICAL DESCRIPTION*
> *Located at 8000 to 9000 feet elevation on the North Rim with slopes from 0% to 60%, including all aspects. Soils are moderately shallow on ridgetops with silty loams occurring in drainage bottoms. All soils are derived from Kaibab limestone parent material.*
>
> *BIOLOGICAL DESCRIPTION*
> *Total canopy cover is at least 25% but can near 100%. It is a mixed conifer forest dominated by Pinus ponderosa, Abies concolor, and Populus tremuloides with the greatest basal area in Pinus ponderosa even though there may be more overstory Abies concolor stems per acre. Other possible overstory species include Pseudotsuga menziesii, Picea pungens, Abies lasiocarpa, and Picea engelmanni. The understory is composed of mostly Abies concolor (25 to 100%), Pinus ponderosa, Populus tremuloides, and Pseudotsuga menziesii. Common brush species are Amelanchier utahensis, Berberis repens, and Robinia neomexicana. Common herbaceous plants include Bouteloua gracilis, Carex spp., Fragaria ovalis, Lotus utahensis, Pedicularis centranthera, and Poa fendleriana.*
>
> *REJECTION CRITERIA*
> *Large rock outcroppings or barren areas >20% of the plot; areas with anomalous vegetation, boundary fences; areas within 30 meters of roads, utility corridors, human-created trails, human-created clearings, or slash piles; areas within 10 meters of significant historic or prehistoric sites or transitional ecotones; areas burned in the last 10 years; areas where majority of basal area is not in ponderosa pine; areas with pole densities that do not include white fir as a major component.* (National Park Service 2000)

There are currently 24 plots installed in this vegetation type, randomized across several North Rim prescribed fire units. Thirteen of these plots have had one year post fire data collected from them.

The pre-treatment measurements from the 24 mixed-conifer plots can give us an indication of what initial pre-burn conditions exist across the vegetation type. We cannot directly address what conditions might be present within subsets of the total area, e.g., the 25% and 10% areas discussed in Table III.B.1.

In the pre-burn measurements on these plots, the 12-18", 18-24", and 24"+ size classes contained 16%, 14%, and 25% of the total stand density index, respectively. This exceeded the desired goal of 10% for each class. Total tree basal area, including all trees >1" DBH, was 219.2 $ft^2$/acre, while density of trees >18" DBH was 30.5 trees/acre. These measurements also exceeded the target/threshold values given in the Recovery Plan, indicating that pre-treatment conditions across the mixed-conifer vegetation type adequately meet the guidelines.

The pre- and post-burn measurements from the thirteen fire effects plots that burned can give us an indication of the effects of low-intensity fire in mixed-conifer habitat. The post-burn measurements were collected one year post-burn. It is important to note that thirteen plots is not a large sample size relative to the type of data collected, and the results from this set of plots are not definitive.

In these thirteen plots, the percent of stand density index represented by the 12-18" size class changed from 18% pre-burn to 21% post-burn. The 18-24" size class changed from 11% of the total stand density index pre-burn to 13% of the total stand density index post-burn. The 24"+ size class changed similarly, from 27% pre-burn, to 29% post-burn. All of the post-burn figures meet or exceed the desired value of 10% for each size class on 25% of the total planning area.

The total tree basal area on these plots, including all trees >1" DBH, decreased from 226.4 $ft^2$/acre pre-burn to 195.2 $ft^2$/acre post-burn. This still exceeds the 150 $ft^2$/acre desired on 25% of the planning area, as well as the 170 $ft^2$/acre desired on 10% of the planning area. The density of trees >18" DBH changed from 30.2 trees/acre pre-burn to 27.2, exceeding the desired goal of 20 trees/acre. The density of trees in the 1-6" size class decreased from 626.7 trees/acre and a stand density index of 87 pre-burn, to 245.1 trees/acre and a stand density index of 42 post-burn. This suggests that the fire successfully removed a portion of the small understory trees.

In addition to recognizing that low-intensity fire achieved target/threshold conditions where it occurred, it is also important to consider what proportion of prescribed fires burn at a low intensity. While we do not have satellite imagery data for prescribed fires to address burn intensity we do have burn severity information.

The Park's Fire GIS Specialist, Fire Ecologist, and Fire Wildlife Biologist were flown over past prescribed fires to assess burn severity. The pilot of the ship

was familiar with the burn areas as he had flown the aerial ignition routes for many of the fires. All mixed conifer forest that was treated with prescribed fire during the past 10 years was flown over and assessed for overstory tree mortality and fire scorch. Areas of high severity were mapped using GPS and GIS technology. The high severity areas for the Atoko fire were also mapped from the ground. The maps of high severity areas produced from the air and ground compared directly. Five fires were flown over with the following results:

| **Burn Name** | **Burn Year** | **Total Acres** | **Acres and % High Severity** |
|---|---|---|---|
| Northwest I | 1992 | 225 | Scattered Trees (< 1 %) |
| Tiyo I | 1997 | 392 | Scattered Trees (< 1 %) |
| Atoko | 1999 | 1,857 | 52 acres (2.8 %) |
| Outlet | 1999 | 4,033 | Scattered Trees (< 5 %) |
| Tiyo 2000 | 2000 | 464 | 1.25 (1 %) |

For these prescribed fire projects we plan on burning approximately 13,172 acres of mixed-conifer habitat and we expect to have pockets of higher intensity burning amounting to less than 5% of this area. However, as fire is an imprecise tool, higher intensity burning amounting to 10% is possible (Chris Marks, GRCA Fuels Specialist, personal communication 2002).

The Grand Canyon Prescribed Fire Program has been ongoing since 1978. In that time, three fires have been converted to wildfires. Of these fires, two stayed within 10 acres of their planned burn perimeter. The third fire, the Outlet 2000 fire, became a large fire that took considerable resources to contain. While the potential for a prescribed fire to exceed its objective exists, the likelihood of it occurring is extremely low. Prescribed fires are currently the Park's safest defense against large uncontrolled fires, such as the Outlet 2000 fire.

See the Mexican Spotted Owl Critical Habitat section which follows for additional discussion of the effects of low intensity fire on specific habitat components.

OTHER FOREST AND WOODLAND TYPES

The Recovery Plan offers no specific guidelines for other forest and woodland types outside of protected and restricted habitat. It states, however, that these types may still be important for the owl as habitat for activities other than nesting and roosting, and offers the following:

> *Guidelines developed for protected and restricted areas may have useful applications when judiciously administered in these other forest and woodland types. Such guidelines include managing for landscape diversity, mimicking natural disturbance patterns, incorporating natural variation in stand conditions, retaining special features such as snags and large trees, and utilizing fires as appropriate. We also emphasize the need for proactive fuels management where appropriate. Decreasing fire risks within these types, particularly ponderosa pine forests, will also decrease fire risks to adjoining protected and restricted areas by minimizing the probability of large landscape-level crown fires that could impinge upon occupied or potential nesting habitat. (*U.S. Fish and Wildlife Service 1995d, p 96)

The other forest type within these project boundaries is pure ponderosa pine. It is expected that the prescribed fire that is applied to this habitat type will burn at a lower intensity than the fire within the mixed-conifer habitat type. We feel that by treating this habitat type with fire we will be providing for the overall forest health and protecting habitat proximate to the spotted owl critical habitat.

### *Effects determination*

We will survey all Mexican spotted owl habitat that is within 0.5 miles of project perimeters prior to project implementation in accordance with the Formal Mexican Spotted Owl Survey Protocol (DOI 2003). All projects that are part of this consultation may take place during the Mexican spotted owl breeding season.

On the North Rim the Northwest I, III, and IV, Walla Valley, Roost, Outlet, and Uncle Jim fire projects may reduce MSO restricted habitat by as much as 10% or 1,317 acres as a result of small patches of moderate to high intensity burning. The Walla Valley, Outlet, and Uncle Jim projects may affect steep slope and or canyon critical habitat through un-planned fire runs over the canyon rim. The Outlet project may result in direct and indirect effects to the Dragon and Trancept PAC's through un-planned fire over the canyon rim, smoke, and noise.

On the South Rim the Horsethief, Shoshone, and Grandview II projects may affect steep slope and or canyon critical habitat through un-planned fire over the canyon rim. The Horsethief project may result in indirect effects from smoke to the Hermit PAC. The Long Jim III project may result in indirect effects to the Pipe Spring PAC from smoke and noise. The Shoshone project

may result in direct effects to the Pipe Spring, O'Neil, Shoshone, and Carmen PAC's through un-planned fire over the canyon rim, smoke, and noise. The Rx 300 and Grapevine projects will be ignited at the same time and may result in indirect effects to the Carmen PAC from smoke and noise. The Hance and Watson projects will be ignited at the same time and may result in indirect effects to the Grandview PAC from smoke and noise. The Grandview II project may result in direct effects to the Grandview and Sinking Ship PAC's through un-planned runs over the canyon rim, smoke, and noise.

Given the above information, we conclude that these projects may adversely affect the Mexican spotted owl.

**POTENTIAL FOR CUMULATIVE EFFECTS OF NON-FEDERAL ACTIONS TO MEXICAN SPOTTED OWLS**

We are aware of no other non-federal activities occurring in or around the project area which would cause cumulative effects, adverse or otherwise, to the Mexican spotted owl.

# XIII. MEXICAN SPOTTED OWL CRITICAL HABITAT

## BACKGROUND

The final rule designating critical habitat for the Mexican spotted owl became effective on March 5th, 2001. Critical habitat units were designated in New Mexico, Arizona, Utah, and Colorado. Within the designated boundaries, all protected or restricted habitat as described in the Recovery Plan is considered critical habitat.

All critical habitat designations must consider the physical and biological features of habitat that are essential to the conservation of the species. These are called the primary constituent elements of the critical habitat, and for the Mexican spotted owl, include those features that support nesting, roosting, and foraging. Because the owls are found in both forest and canyon habitat, primary constituent elements were defined for each type of habitat. These are as follows:

### *Forest habitat*

- high basal area of large diameter trees
- moderate to high canopy closure
- wide range of tree sizes suggestive of uneven-age stands
- multi-layered canopy with large overstory trees of various species
- high snag basal area
- high volumes of fallen trees and other woody debris
- high plant species richness, including hardwoods
- adequate levels of residual plant cover to maintain fruits, seeds, and regeneration to provide for the needs of Mexican spotted owl prey species

### *Canyon habitat*

- cooler and often more humid conditions than the surrounding area
- clumps or stringers of trees and/or canyon wall containing crevices, ledges, or caves
- high percent of ground litter and woody debris
- riparian or woody vegetation (although not at all sites)

## MEXICAN SPOTTED OWL CRITICAL HABITAT AT GRAND CANYON NATIONAL PARK

### *Forest habitat*

The planned prescribed fire projects contain 13,172 acres of mixed-conifer restricted critical habitat.

As discussed in the previous section, mixed-conifer habitat in the park appears to meet the target/threshold conditions outlined in the Recovery Plan. We will discuss the specifics of the primary constituent elements below, in the effects section.

### *Canyon habitat*

Eight PAC's representing about 6,948 acres is designated critical habitat and is within canyon terrain. Other steep slope and critical canyon habitat is not quantified. However, as mentioned in the previous section we will limit the amount of fire entering PAC's to 1,200 acres and other steep slope and canyon critical habitat to 2,500 acres.

#### CONSERVATION MEASURES FOR MEXICAN SPOTTED OWL CRITICAL HABITAT

- Park wildlife biologists will be consulted early in the decision-making process for prescribed fires.
- To minimize negative effects on the primary constituent elements of critical habitat, prescribed fires will be managed as low-intensity fires, as discussed in the project description.
- If fireline construction is necessary, we will minimize the cutting of trees and snags larger than 18" DBH, and no trees or snags larger than 24" DBH will be cut unless absolutely necessary for safety reasons.
- If fireline construction is necessary, we will rehabilitate the line after use. This will be done by pulling soil, duff, litter, woody debris, and rocks back onto the line to bring it up to grade and to make it blend in with the surrounding area.
- The park will perform a burn severity analysis on the prescribed fires and will quantify and map the areas of the project that burn at the varied intensity levels. This map will be provided to USFW.

#### EFFECTS OF THE PROPOSED ACTION ON MEXICAN SPOTTED OWL CRITICAL HABITAT

### *Forest habitat*

As we did for the Mexican spotted owl target/threshold habitat conditions, we can use the 13 fire effects monitoring plots which burned in mixed-conifer on the north rim to illustrate the effects of a low-intensity fire on the primary constituent elements of critical habitat.

### *High basal area of large diameter trees*

On the 13 plots, basal area of trees larger than 18" DBH changed from 115.9 $ft^2$/acre pre-burn to 103.7 $ft^2$/acre post-burn.

### *Moderate to high canopy closure*

Our fire effects data does not address canopy closure directly. Results from the fire effects plots suggest that canopy closure may be reduced through removal of small trees, but that the larger trees will remain. We expect that these will provide at least moderate canopy closure.

### *Wide range of tree sizes suggestive of uneven-age stands*

In the post-burn measurements of the 13 plots, the percent of the total stand density index represented by the 0-6", 6-12", 12-18", 18-24", and 24"+ DBH size classes were 23%, 20%, 18%, 11%, and 27%, respectively. This distribution suggests an uneven-age stand.

### *Multi-layered canopy with large overstory trees of various species*

The wide range of tree sizes present on the 13 plots suggests that the canopy will also be multi-layered; this is confirmed by field observation. Various species are also present, with the trees larger than 18" DBH remaining post-burn including ponderosa pine (18.9 trees/acre), white fir (6.9 trees/acre), and douglas-fir (0.6 trees/acre).

### *High snag basal area*

On the 13 plots, basal area of snags 18" DBH and larger changed from 24.6 $ft^2$/acre pre-burn to 23.1 $ft^2$/acre post-burn.

### *High volumes of fallen trees and other woody debris*

On the 13 plots, the total woody fuel load was 19.3 tons/acre pre-burn, including 14.6 tons/acre of fuels greater than 3" in diameter. Post-burn, the total fuel load was 11.9 tons/acre, with 8.8 tons/acre of fuels greater than 3" in diameter.

### *High plant species richness, including hardwoods*

We have not collected data on the13 plots for a long enough period of time to evaluate this element. In general, however, we expect that thinning of the canopy as well as reduction of fuel loads on the forest floor should allow increased diversity. Patches of high intensity fire within the burn may create opportunities for regeneration of aspen, one of the few common hardwoods in the mixed-conifer vegetation type. The 13 plots contained 6.9 aspen trees/acres in the 6-12" and 12-18" DBH size classes, post-burn.

### *Adequate levels of residual plant cover to maintain fruits, seeds, and regeneration to provide for the needs of Mexican spotted owl prey species*

Again, we do not yet have enough data from the 13 plots to evaluate residual plant cover. Our monitoring experience from prescribed fires suggests that low intensity fire leaves a mosaic of residual plant cover, and also allows plant cover to return rapidly.

***Canyon habitat***

Where prescribed fire overlaps with canyon habitat it is likely to be in areas where canyon habitat also displays many of the characteristics of forest habitat.

***Cooler and often more humid conditions than the surrounding area***

This element will be affected by fire where it was dependent on vegetation rather than topography.

***Clumps or stringers of trees and/or canyon wall containing crevices, ledges, or caves***

Clumps or stringers of trees could be affected as described above in the discussion of forest habitat. Other elements would not be affected.

***High percent of ground litter and woody debris***

Woody debris could be removed by a fire, as discussed above.

***Riparian or woody vegetation (although not at all sites)***

Woody vegetation could be affected as described above, but it is highly unlikely that riparian vegetation would be affected by the prescribed fires.

***Effects determination***

Preliminary results from our monitoring program indicate that prescribed fires will allow us to reduce the risk of catastrophic wildfire, while still maintaining and developing the primary constituent elements of critical habitat overall. Our fire effects data and burn severity analyses suggest that any potential adverse effects of prescribed fires to spotted owl critical habitat would be limited to small patches of moderate – high or high intensity fire.

Past analyses have shown that these patches of higher intensity burning have amounted to less than 5% of the project areas. However, as fire is a dynamic process, as much as 10% of restricted critical habitat within the project areas may receive higher intensity burning. For these projects this amounts to 1,317 acres of habitat receiving higher intensity burning.

As previously mention we will limit the amount of fire entering PAC's to 1,200 acres and other steep slope and canyon critical habitat to 2,500 acres. As the steep slopes of canyon terrain can lead to higher intensity burning we estimate that as much as 10% of these areas may result in higher intensity burning. For these projects this amounts to 120 acres within PAC's and 250 acres within canyon critical habitat.

For these reasons we conclude that these projects may adversely affect the Mexican spotted owl critical habitat.

**POTENTIAL FOR CUMULATIVE EFFECTS OF NON-FEDERAL ACTIONS TO MEXICAN SPOTTED OWL CRITICAL HABITAT**

We are aware of no other non-federal activities occurring in or around the project area which would cause cumulative effects, adverse or otherwise, to Mexican spotted owl critical habitat.

# XIV. CALIFORNIA CONDOR

## BACKGROUND

The California condor (*Gymnogyps californianus*) is a member of the family Cathartidae or New World vultures, a family of seven species, including the closely related Andean condor (*Vultur gryphus*) and the turkey vulture (*Cathartes aura*) (U.S. Fish and Wildlife Service 1996).

California condors are among the largest flying birds in the world. Adults weigh approximately 10 kilograms (22 lbs.) and have a wing span up to 2.9 meters (9.5 ft). Adults are black except for prominent white underwing linings and edges of the upper secondary coverts. The head and neck are mostly naked, and the bare skin is gray, grading into various shades of yellow, red, and orange. Males and females cannot be distinguished by size or plumage characteristics (U.S. Fish and Wildlife Service 1996).

The California Condor was listed as endangered on March 11, 1967, in a final rule published by the U.S. Fish and Wildlife Service. The Service then established critical habitat for the California condor nine years later on September 24, 1976. Long recognized as a vanishing species, the California condor remains one of the world's rarest and most imperiled vertebrate species. Despite intensive conservation efforts, the wild California condor population declined steadily until 1987, when the last free-flying individual was captured. During the 1980s, captive condor flocks were established at the San Diego Wild Animal Park and the Los Angeles Zoo, and the first successful captive breeding was accomplished at the former facility in 1988. Following several years of increasingly successful captive breeding, captive-produced condors were first released back to the wild in early 1992 (U.S. Fish and Wildlife Service 1996).

In 1996, condors were released into the Vermilion Cliffs area in Coconino County, Arizona, approximately 60 miles north of Grand Canyon National Park. The released birds in Arizona are characterized as a "10(j)" population. This refers to its experimental population status under section 10(j) of the Endangered Species Act. By declaring the population "non-essential, experimental", the Fish and Wildlife Service can treat condors in the project as "threatened" and develop regulations for management of the population that are less restrictive than mandatory prohibitions covering endangered species. This designation provides increased opportunities for assuring that the release and management of the condors does not disrupt or conflict with other activities. Within Grand Canyon National Park, the condor has the full protection of a threatened species.

**CONDOR SURVEYS IN GRAND CANYON NATIONAL PARK**

Following the release of condors in Arizona in 1996, the birds have matured and become skilled flyers, moving farther and farther from the release site. Each bird has been fitted with a radio transmitter that allows accurate tracking of their movements and behavior. The monitoring plan in the final environmental assessment dealing with the condor release calls for continued tracking of the birds for the first two to three years following their release (Peregrine Fund 1996). Although ground triangulation is the primary means of radiotracking, aerial and satellite tracking methods are also used to locate birds.

Since the time of the initial release in Arizona of immature birds in 1996, data on bird activity away from the release site have been collected by the Peregrine Fund and by Grand Canyon National Park.

In addition to the Grand Canyon area, condors have been observed west to the Virgin Mountains near Mesquite, Nevada, south to the San Francisco Peaks near Flagstaff, Arizona, north to Zion and Bryce Canyon National Parks and beyond Minersville, Utah, and east to Mesa Verde, Colorado, and the Four Corners region.

Monitoring data indicate that the condors are using habitat throughout the park, with concentration areas in Marble Canyon, Desert View to the Village on the South Rim, and the Village to Hermits Rest on the western portion of the South Rim. The majority of summer activity of the birds occurs on the South Rim, but includes both North and South Rim visitation areas.

**CONSERVATION MEASURES FOR THE CALIFORNIA CONDOR AND ITS HABITAT**

- All helicopter dip tanks will be covered when not in use.
- All fire personnel will be provided literature or instructed regarding condor concerns.
- Any presence of condors in the project area will be recorded and reported immediately to the Resource Advisor or a park wildlife biologist.
- If condors arrive at any area of human activity associated with prescribed fire activities, the birds will be avoided. The assigned Resource Advisor or a park wildlife biologist will be notified, and permitted personnel will haze the birds from the area.
- No non-permitted personnel will haze condors.
- All camp areas will be kept free from trash.
- Aircraft use along the rim of the Grand Canyon will be minimized to the greatest extent possible.

- Biologists will contact the Peregrine Fund daily (at 928-606-5155 or 928-380-4667) during prescribed fire operations involving aviation to check on locations of condors.
- If any fire retardant chemicals must be used, the application area will be surveyed and any contaminated carcasses will be removed before they become condor food sources.
- Aircraft will remain 400 meters from condors in the air or on the ground unless safety concerns override this restriction.
- If airborne condors approach aircraft, aircraft will give up airspace to the extent possible, as long as this action does not jeopardize safety.
- The park will adhere to the air quality standards set by the Arizona Department of Environmental Quality.
- Prescribed fire projects will not occur within 0.5 miles of active condor nesting sites.

#### EFFECTS OF THE PROPOSED ACTION ON THE CALIFORNIA CONDOR AND ITS HABITAT

### *Fire*

The mobility of condors, and the fact that they rarely nest in forested habitat, make the possibility of direct mortality from fire highly unlikely.

### *Noise and Visual Disturbance*

Although most management of prescribed fires involves minimal activity, if suppression actions are necessary, the noise and activity associated with fireline construction, helicopter water drops, and crew staging areas could potentially disturb condors in the area. Studies of the physiological and behavioral responses of condors to noise and visual stimuli have not been undertaken, but such effects have been studied in other raptor species. A discussion of the these effects can be found in the previous section on the Mexican spotted owl. The studies discussed suggest that disturbance from prescribe fire activities could range from none at all to flushing birds from perching, roosting, or scavenging sites.

Although general disturbance from noise and activity is possible, it is also likely that condors will be attracted to any areas with high levels of activity associated with prescribed fire operations. Condors are naturally curious and it is not uncommon to observe them in busy areas, such as Grand Canyon Village on the South Rim. During the Vista wildland fire use fire of 2001, 15 condors had to be hazed from the North Rim helibase water tank several times. This problem was resolved by covering the water tank, after which these condors stopped returning. After this all water tanks were covered when not in use, and this practice has been adopted as a conservation measure.

This attraction to busy sites may increase the potential for interaction between condors and humans, which would be of concern if non-permitted personnel haze the birds, or if the birds become habituated to humans. Educating firefighters and other personnel about condor concerns (as described in the conservation measures, above) will reduce potential disturbance from suppression and monitoring activities. Normal mitigation measures in construction projects require crews to stop activity if condors arrive on the site. However, it will not be possible for firefighters to cease activity if condors are attracted to fireline construction areas during the fire. Instead, the resource advisor assigned to the fire will be notified of the presence of condors and will arrange for hazing of the condors by permitted personnel. This will reduce the likelihood of negative effects to condors from human interactions.

***Smoke***

Condors are highly mobile birds, able to travel over 100 miles in a single day, and using home ranges of well over a million acres (U.S. Fish and Wildlife Service 1996). Because of their mobility, and the fact that they are not closely tied to one small habitat area, they should be able to easily escape any smoke generated by prescribed fires. Negative effects would be limited to minor disturbance in most situations.

The only occasion when smoke might present a major disturbance or hazard would be if large amounts of smoke were to enter the canyon near nesting condors. Because the condors are monitored via radiotelemetry, the locations of any nests should be known, and this information would be incorporated into any decision to proceed with a prescribed fire.

Nesting condors would be additionally protected by the park's adherence to the ADEQ air quality standards. The park is a Mandatory Federal Class I area for air quality under the Clean Air Act, making the park, and fire management, subject to stringent air quality standards set by the Arizona Department of Environmental Quality (ADEQ). Amounts of smoke which would be associated with a violation of the ADEQ standards would also be likely to pose risks for visitors, and by extension, to wildlife. Because such a violation would be a serious problem for the park, every effort is made to avoid this during any prescribed fire operation. First, such operations are only conducted when weather forecasts and current conditions indicate that smoke will be carried up and away from the canyon on the prevailing southwest winds. Second, various methods of air quality monitoring (dataRAM particulate monitors, transmissometers, photo points) are employed at several locations in Grand Canyon during such operations. The data collected is analyzed on a continuous basis and the results are passed on to fire managers and to ADEQ. If an impending violation is detected, fire managers will adjust management strategies to reduce smoke production and avoid the violation. These factors should help to prevent serious negative effects to less mobile nesting condors.

### *Collisions with Aircraft*

Based upon observations made during the wildland fire use fires of 2001, the park helicopter and condors are sharing the same airspace. Although there have been no collisions or near-collisions, the potential does exist. There are no data available documenting the number of collisions between aircraft and birds within Grand Canyon National Park (Grand Canyon Airport Tower, pers. comm.).

The final environmental assessment for the condor release at Vermilion Cliffs states that:

> *The release should not affect operations at the Marble Canyon or Cliff Dwellers airstrips. There are no records in the literature describing condor collisions or near-collisions with aircraft. Further, the risks to aircraft from soaring condors should be no greater than those from other large bird species (golden eagles and turkey vultures) already present in the area. The condors' large size and predictable flight patterns make them highly visible to pilots and help to minimize aircraft risks*. (Peregrine Fund 1996).

The environmental assessment does not address proximity of condors to helicopter flight operations during fire suppression activity. It is reasonable to assume that any increased aviation activity associated with prescribed fire, and the possible attraction of condors to other prescribed fire activity, could increase the overall risk of a collision.

It is important to note that a collision with a condor would be a serious hazard to the safety of any aircraft, and for that reason, will be avoided at all costs by the pilot. We expect that the conservation measures that are in place, as well as general aviation safety practices, will keep the probability of collisions low, and that there will be no negative effects to condors from prescribed fire-related aviation.

### *Damage to habitat*

Prescribed fire projects have the potential to damage condor roosting habitat within project areas. Some roost sites, such as large trees or snags, could be damaged, but most would only be temporarily unavailable while fire was present. Because many roosting sites are available throughout the Park, and condors could easily move to those sites, negative effects would be more related to disturbance than to permanent habitat damage.

Prescribed fire projects also have some potential to contaminate condor food sources. Although it would not be a usual project-related event, it is possible

that aerially-applied fire retardant might be used in suppression activities. If this were to occur, the application area would be surveyed as soon as possible following the application so that any contaminated carcasses could be removed before becoming condor food sources.

**EFFECTS DETERMINATION**

Prescribed fire activities may increase the potential for condors' habituation to humans, for collisions between condors and aircraft, for damage to condor habitat, and for disturbance to condors by personnel, aircraft, or smoke. Although we feel that, with the above-stated conservation measures in place, the potential for these effects to occur is small, it does exist. For that reason, we conclude that these projects may adversely affect the California condor.

**POTENTIAL FOR CUMULATIVE EFFECTS OF NON-FEDERAL ACTIONS TO THE CALIFORNIA CONDOR**

We are aware of no non-federal actions that would cause cumulative effects to the California condor or its habitat.

# XV. SUMMARY OF CONSERVATION MEASURES

The following conservation measures have been adopted as part of the project description, and will be adhered to during project operations, **unless such adherence compromises safety**.

## GENERAL CONSERVATION MEASURES

General conservation measures which apply to all prescribed fire projects were discussed in section II, Background Information and Project Description. These measures include:

- Using only low intensity fires for prescribed fires
- Monitoring fire effects for adaptive management
- Reporting results to U.S. Fish and Wildlife Service
- Planning to minimize negative impacts
- Adherence to conservation measures

## SPECIES-SPECIFIC CONSERVATION MEASURES

### *Sentry milk-vetch*

- No prescribed fires, nor fire-related activities, will be allowed to encroach upon known sentry milk-vetch populations.
- If unsurveyed areas of potential habitat are included within the project boundary we will evaluate the potential for fire to enter the habitat. If it appears that fire could move through the potential habitat, we will survey this habitat prior to project implementation. Fire will not be allowed to enter any habitat found to be occupied.

### *Brady pincushion cactus*

- None needed.

### *Kanab ambersnail*

- None needed

### *Humpback chub*

- Erosion control measures will be used if needed.

### *Humpback chub critical habitat*

- Erosion control measures will be used if needed.

### *Southwestern willow flycatcher*

- The park will adhere to the air quality standards set by the Arizona Department of Environmental Quality.

### *Bald eagle*

- The park will adhere to the air quality standards set by the Arizona Department of Environmental Quality.

- A 1000 foot no-flight perimeter will be established around the observed roost locations at Twin Overlooks from October 1 to April 1.

### *Desert tortoise*

- None needed.

### *Mexican spotted owl*

- Park wildlife biologists will be consulted early in the decision-making process for prescribed fires.
- To minimize negative effects on habitat, fires will be managed as low-intensity fires, as discussed in the project description.
- The park will adhere to the air quality standards set by the Arizona Department of Environmental Quality.
- If fireline construction is necessary, we will minimize the cutting of trees and snags larger than 18" DBH, and no trees or snags larger than 24" DBH will be cut unless absolutely necessary for safety reasons.
- If fireline construction is necessary, we will rehabilitate the line after use. This will be done by pulling soil, duff, litter, woody debris, and rocks back onto the line to bring it up to grade and to make it blend in with the surrounding area.
- To the maximum extent possible, aircraft will remain at least 1000 feet from the boundary of any designated Protected Activity Center.
- If Mexican spotted owls are discovered during project activities, a park wildlife biologist will be notified immediately.
- Firefighters will not approach or haze Mexican spotted owls, if found.
- We will survey known PACs that can be surveyed from the rim, and that are adjacent to project areas prior to project implementation.
- We will survey all Mexican spotted owl habitat that is within 0.5 miles of project perimeters prior to project implementation in accordance with the Formal Mexican Spotted Owl Survey Protocol (DOI 2003).
- Efforts to locate spotted owl nest sites will be made prior to project implementation so that potential affects can be better monitored.

## EFFECTS OF THE PROPOSED ACTION ON THE MEXICAN SPOTTED OWL

### *Mexican spotted owl critical habitat*

- Park wildlife biologists will be consulted early in the decision-making process for prescribed fires.
- To minimize negative effects on the primary constituent elements of critical habitat, prescribed fires will be managed as low-intensity fires, as discussed in the project description.
- If fireline construction is necessary, we will minimize the cutting of trees and snags larger than 18" DBH, and no trees or snags larger than 24" DBH will be cut unless absolutely necessary for safety reasons.

- If fireline construction is necessary, we will rehabilitate the line after use. This will be done by pulling soil, duff, litter, woody debris, and rocks back onto the line to bring it up to grade and to make it blend in with the surrounding area.
- The park will perform a burn severity analysis on the prescribed fires and will quantify and map the areas of the project that burn at the varied intensity levels. This map will be provided to USFW.

### *California condor*

- All helicopter dip tanks will be covered when not in use.
- All fire personnel will be provided literature or instructed regarding condor concerns.
- Any presence of condors in the project area will be recorded and reported immediately to the Resource Advisor or a park wildlife biologist.
- If condors arrive at any area of human activity associated with prescribed fire activities, the birds will be avoided. The assigned Resource Advisor or a park wildlife biologist will be notified, and permitted personnel will haze the birds from the area.
- No non-permitted personnel will haze condors.
- All camp areas will be kept free from trash.
- Aircraft use along the rim of the Grand Canyon will be minimized to the greatest extent possible.
- Aviation personnel will contact the Peregrine Fund daily (at 520-606-5155 or 520-380-4667) during prescribed fire operations involving aviation to check on locations of condors.
- If any fire retardant chemicals must be used, the application area will be surveyed and any contaminated carcasses will be removed before they become condor food sources.
- Aircraft will remain 400 meters from condors in the air or on the ground unless safety concerns override this restriction.
- If airborne condors approach aircraft, aircraft will give up airspace to the extent possible, as long as this action does not jeopardize safety.
- The park will adhere to the air quality standards set by the Arizona Department of Environmental Quality.
- Prescribed fire projects will not occur within 0.5 miles of active condor nesting sites.

## XVI. SUMMARY OF EFFECTS DETERMINATION

***Sentry milk-vetch***
- May affect, not likely to adversely affect

***Brady pincushion cactus***
- No effect

***Kanab ambersnail***
- No effect

***Humpback chub***
- May affect, not likely to adversely affect

***Humpback chub critical habitat***
- May affect, not likely to adversely affect

***Southwestern willow flycatcher***
- May affect, not likely to adversely affect

***Bald eagle***
- May adversely affect

***Desert tortoise***
- No effect

***Mexican spotted owl***
- May adversely affect

***Mexican spotted owl critical habitat***
- May adversely affect

***California condor***
- May adversely affect

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# Appendix F

# Fire Effects Monitoring Plan

# Grand Canyon National Park
# Fire Effects Monitoring Plan

## April 1, 2000

GRAND CANYON

NATIONAL PARK

# Grand Canyon National Park

# Fire Effects Monitoring Plan
# April 1, 2000

_____

**Prepared by Fire Effects Specialist**
**Date**

_____

**Recommended by Prescribed Fire Manager**
**Date**

_____

**Approved by Chief, Natural Resources**
**Date**

_____

**Approved by Chief, Fire and Aviation**
**Date**

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## Introduction

There are still questions about Grand Canyon's fire ecology, but the fire management program can manage ecosystems effectively by utilizing an adaptive management strategy as answers are provided through the Fire Effects Monitoring Program. Fire managers will continue to learn more about fire effects on vegetation and fuels with thorough monitoring efforts, prompting refined fire prescriptions and more effective future uses of prescribed fire. **The purpose of this plan is to guide fire monitoring activities at Grand Canyon National Park, ensuring information is collected consistently each year.**

The Fire Effects Monitoring Program focuses on four monitoring types at this time—South Rim Great Basin Conifer Woodland, South Rim Ponderosa Pine, North Rim Ponderosa Pine, and North Rim Ponderosa Pine with White Fir Encroachment. Many variables are measured in each ecosystem, but the focus is mainly on overstory trees, pole trees, and total fuel load. Additional monitoring types are under development for North Rim Meadows and North Rim Spruce-Fir. A forest and brush type may be established in Great Basin Conifer Woodlands for future fires of high intensity. Undeveloped monitoring types are not addressed in this plan.

The management of wildland fires depends on whether the fire is within prescription parameters as outlined in the Fire Management Plan. The fire will either be suppressed or managed as a Wildland Fire Use for Resource Benefits (WFURB) fire. Wildland Fire Use incidents are monitored and documented, but long-term fire effects are not studied under the program detailed in this document. This Fire Effects Monitoring Plan outlines efforts in monitoring all fires that occur at Grand Canyon National Park and in monitoring long-term vegetation and fuel load changes as a result of prescribed burning.

## What is Monitoring?

It is important to understand what "monitoring" means, but many people interpret it differently. By definition, monitoring

- is a powerful tool that, if implemented early, can identify problems before they become crises:
- can be used to measure management success:
- is characterized, primarily, by objectives and being part of an adaptive management cycle:
- is not "research" (Elzinga et al. 1998).

"Surveillance" is the collective term used to describe measurements that document change over time, but are *not* used to make better resource management decisions. However, the actual monitoring techniques and analysis may be the same for both (Elzinga et al. 1998). The GRCA Fire Effects Monitoring Program employs all the necessary techniques and analysis used in a comprehensive monitoring program, except that "management responses" have not been articulated. Therefore, by the above definition, the GRCA Fire Effects Monitoring Program is not part of an adaptive management cycle. The prescribed

fire staff is actively working on changing this fact by sharing prescribed fire management information with resource management staff in order to collaborate in identifying trends, solutions, and management actions. This information sharing takes place through an annual two-day meeting and distribution of a comprehensive data analysis report. With continued collaborative efforts, GRCA may have a true adaptive management cycle in place for prescribed fire management. However, for the purpose of this report, "monitoring" will be used to describe the techniques outlined in the "1992 Western Region Fire Monitoring Handbook" (National Park Service 1992).

Monitoring is not research. Research is more rigorous in that control plots are in place to determine cause and effect of a certain treatment with statistical significance. Fire Effects Monitoring plots are not supplemented by control plots, therefore statistically significant inferences about cause and effect cannot be determined. Monitoring results can "raise a red flag" and a research study can be initiated to study the fire effects further.

## Fire Effects Monitoring Goals

The primary aim of the Fire Effects Monitoring Program is to provide information to fire and resource managers, which allows them to affirm that prescribed fire objectives are being met or to identify and correct deficiencies. Fire Effects monitoring at Grand Canyon National Park is focused on pinyon-juniper woodlands and ponderosa pine associations at this time.

Table 1 lists the goals for the Grand Canyon Fire Monitoring Program in the first column. The remaining columns list key positions in the Grand Canyon Fire Monitoring Program and where their responsibilities lie. Some of these responsibilities are on going, while others need review only annually. This table helps eliminate confusion about where different positions fit into the big fire monitoring picture.

**Table 1. Fire Effects Monitoring Program Goals and Responsibilities**

| Fire Monitoring Program Goals | Resource Manager | Rx Fire Manager | Rx Fire Specialist | Fire Effects Specialist | Lead Fire Monitor | Field Monitors | Regional Fire Ecologist |
|---|---|---|---|---|---|---|---|
| Collect data, enter data, manage data. | | | | | ● | ● | |
| Lead the Fire Effects Monitoring Crew in the field on a daily basis. | | | | | ● | | |
| Supervise the Fir e Effects Monitoring Program. | | ● | | ● | | | |
| Provide quality control guidelines for data collection and management. | | | | ● | ● | | ● |
| Analyze data and provide written fire reports to verify objectives are met. | | | | ● | ● | ● | |
| Ensure personnel safety during field and office work. | | ● | ● | ● | ● | ● | |
| Document basic information for all prescribed fires and keep all monitoring information organized and properly backed-up | | ● | ● | ● | ● | ● | |
| Identify areas in which research should be initiated | ● | ● | ● | ● | | | ● |
| Facilitate communication within the park, and between monitoring programs within the region, the NPS, and interagency | ● | ● | ● | ● | | | ● |

# Grand Canyon National Park Forest and Woodland Vegetation

Due to extreme differences in climate, soils, and terrain, Grand Canyon National Park supports riparian habitats, hot desert scrub, pinyon-juniper, ponderosa pine, and high-elevation spruce-fir forests. Following, is a short summary of vegetation types where prescribed fire is used. For more information about Grand Canyon vegetation, see:

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- Wolf, Joy J. and Joy N. Mast. 1998. Fire history of mixed-conifer forests on the North Rim, Grand Canyon National Park, Arizona. Physical Geography 19:1-14.

**Spruce-fir forests** dominate the North Rim ridgetops above 8700 feet. On north-facing slopes above 8200 feet, the forest is dominated by subalpine fir, white fir, Engelmann spruce, and aspen with Douglas fir and blue spruce at slightly lower elevations. Ponderosa pine occurs on drier, southwestern-facing sites along with Douglas fir and aspen. There are very few shrubs in this dense forest type, and herbaceous cover is sparse. There are plans to begin prescribed burning in limited areas of this forest on the northeastern park boundary in the Hayden and Vista IV units (Figure 1).

**Mountain meadows** are scattered throughout the forest in shallow valleys between north-south trending ridges. There is a rich diversity of grasses and forbs in these areas. It appears that soil moistures and cold temperatures inhibit seedling establishment in the meadows, although edges are being invaded by conifers and aspen (Moore 1994). Fire may be used in and around meadows to prevent encroachment by tree species.

**Ponderosa pine forests** occur between 7000-8200 feet on both rims, mixing with pinyon-juniper at lower elevations, and with spruce-fir forests at higher elevations. At the higher elevations on the North Rim, what was once ponderosa pine-dominated forest is being severely encroached by white fir due to fire suppression activities over the last 100 years. Pure stands of ponderosa pine can be found on the most southern plateaus of the North Rim and in drainages on the South Rim. Ponderosa pine forests burned every 2-15 years before fire suppression activities (Duhnkrack 1982, Swetnam and Baisan 1996).

**Pinyon-juniper woodlands** occur below the ponderosa pine and extend into the canyon in many areas. Dominanted by *Pinus edulis* and *Juniperus osteosperma*, pinyon-juniper forests are limited on the North Rim to the southern tips of the plateaus that extend into the canyon, but are the most dominant cover type on the South Rim. A well-developed understory of shrubs and herbs is present. Pinyon-juniper forests surrounding the South Rim Village have been burned by hand ignition and "jack-potting" over the past 10 years to reduce the threat of wildfire. Jack-potting refers to a method by which fire crews walk through the forest and stack scattered fuels into piles for greater consumption when the piles are ignited. Numerous open areas exist in this forest type along the South Rim as a result of high-intensity, stand-replacement wildfires.

The area treated by prescribed fire exists, for the most part, on the rims of the Grand Canyon, in forested areas. Occasionally, a fire may creep down slope over the rim into scrub but does not usually burn below the Coconino layer. At this time, prescribed fire has not been used in grass-dominated ecosystems on the rims.

## Monitoring Levels

There are four fire monitoring levels: (1) Reconnaissance, (2) Fire Conditions, (3) Immediate Post-fire Effects, and (4) Long-term Change. Tasks are cumulative—conditions monitored at higher levels include all tasks at lower levels. Every fire is monitored at levels 1 and 2 no matter if it contains long-term vegetation and fuel monitoring plots (FMH plots). For Levels 3 and 4, permanent monitoring plots are randomly distributed over a monitoring type that contains many prescribed burn units. Some burn units have more than five plots, while others have none. The plots are meant to monitor trends in vegetation at a landscape level, not to detect change in individual burn units. To monitor each burn unit at a statistically valid level with long-term vegetation monitoring plots is unrealistic because it would necessitate hundreds of plots.

On occasion, we may choose to forego full plot installation in a burn unit and opt to monitor only 1 or 2 variables, using the same protocols as for the full plot

installation. For example, if fuel load reduction is of primary concern on a particular unit and no FMH plots exist on this unit, only Brown's transects may be installed and monitored to obtain accurate results for this variable. Some areas can be monitored long-term using photo points, instead of vegetation or fuel measurements. Photographs can provide a useful qualitative record of change. Consultation between the Burn Boss, the Prescribed Fire Manager, and the Fire Effects Specialist will determine what levels of monitoring are needed for burn units.

### *Level 1 Monitoring: Reconnaissance*

Level 1 monitoring is "reconnaissance" and utilized when a fire has little potential for growth and is located in an inaccessible area. Fire location, size, fuel type, activity, and potential for spread are recorded as well as resource concerns and smoke movement. Most Level 1 monitoring is done via helicopter at a frequency decided by the Burn Boss or Incident Commander (IC). *Level 1 monitoring alone is rarely utilized for monitoring prescribed fires* unless it is late in the burning season and the prescribed fire is relatively inactive but not declared "out". During late-season burns aerially ignited on the North Rim, monitors may only be able to collect Level 1 information via helicopter flights or photographs from the South Rim.

### *Level 2 Monitoring: Fire Conditions*

Level 2 monitoring includes fire conditions *and* reconnaissance for all fires in the park. Monitors may have a few days to a few weeks to prepare for monitoring a prescribed fire. Preparation includes a variety of tasks and there are many forms for documenting prescribed fire information at Grand Canyon (Appendix A). If a fire is ignited by air on the North Rim late in the season, and no fire monitors are on-site, fire conditions will be documented by the Burn Boss and recorded on the form RX-6: Daily Prescribed Fire Monitoring Report. For a WFURB, the assigned fire monitor will document fire conditions as appropriate.

All prescribed fire monitoring information and a copy of the burn plan is kept in binders in the fire office. **All** prescribed fire monitoring documentation must be put in these files, whether originals or photocopies, including slides and photos from the fire. Operational information is kept in a separate file in the Prescribed Fire Manager's office. WFURB documentation goes to the IC or the files kept in Fire Dispatch.

*Tasks Associated with Monitoring a Prescribed Fire*

Days/Weeks before ignition:

1. Understand burn objectives
2. Get familiar with burn unit boundaries
3. Establish photo points for smoke/vegetation at Burn Boss' request
4. Make sure Monitoring Kit is ready (list of required items is in Appendix B of this document)
5. Sample fuels, monitor 10-hour sticks, and rain gauges at Burn Boss' request
6. Install pin flags for Fire Behavior Observation Circles (FBOCs)
7. Request spot weather forecasts for days preceding ignition at Burn Boss' request
8. Deploy Data-RAM 2000 at Burn Boss' request

Day of Ignition:

1. Attend briefing
2. Bring Monitoring Kit and helium tank to location for releasing pibal
3. Report pibal results to Burn Boss
4. Monitor fire throughout burning period with smoke, fire, and weather observations, and photos. Take notes to use in narrative report.
5. Monitor smoke throughout burning period and throughout evening at Burn Boss' request.
6. File all paperwork in 3-ring binder for that burn unit
7. File photo record sheets in binder for "photos to be matched with record sheets".

Day(s) after ignition:

1. Go to photo points to take smoke photos as soon as it's light enough for a good exposure
2. Monitor smoke as needed in sensitive areas at Burn Boss' request
3. Send film in for processing ASAP
4. Re-stock monitoring kit from cache
5. Identify needs for re-supply/ordering
6. Monitor Data-RAM 2000 at Burn Boss' request

Two weeks after burning of unit is completed:

1. File processed photos as they come back
2. Collect and summarize documentation from DataRAM 2000 using template for graphs
3. Give final monitoring report to Burn Boss and Prescribed Fire Manager
4. File final monitoring report in burn unit binder

Six-to-Ten weeks after burn is completed:

1. When appropriate, give written report on post-burn fire effects to Rx Fire Manager. This is necessary if FMH plots were burned in the unit or subunit.

## *Forms to Use when Monitoring a Prescribed Fire*

### RX-1: Weather observations

This form is mostly self-explanatory. The burn boss will dictate how often weather observations should be taken. Take observations from a variety of locations (valley bottoms, ridgetops, southwest slopes, etc). Report observations over the tactical channel so all firefighters are aware of changing weather conditions. Indicate when critical levels are reached (low fuel moistures, gusty winds, etc). Fill out the header completely. Read the burn plan to understand the prescription and inform Burn Boss if weather observations fall outside of prescription.

### RX-2: Pilot Balloon observations

At Grand Canyon National Park a pilot balloon (pibal) is released before every prescribed burn to indicate where the smoke will travel. Take the helium tank to the field with the monitoring kit. Pibal instructions and accessories are in the kit. Record pibal information on the form and relay information on wind direction to Burn Boss. If the pibal shears off, winds are strong, and if it rises straight up, winds are light. Estimate where smoke will go in relation to sensitive areas (highways, canyon, villages, and trails).

### RX-3: Smoke observations

Smoke is one of the most critical factors in the decision to ignite a prescribed fire at Grand Canyon National Park. Before ignition, identify points where smoke observations can be taken. These points should be easy to locate again and should provide a view of the smoke column and nocturnal drainage areas. Also consider establishing photo points where there will not be smoke impacts, to document existing haze. Take observations and photographs at these points numerous times throughout the day. Try to choose only a few points and take repeated photos from the same locations, rather than lots of pictures at lots of different places. Strive for comparable photos. Also, choose photo points in areas where smoke may be a problem (highways, canyon, villages, and critical receptors identified in the burn plan) and monitor smoke in these areas. Consult with the Burn Boss and read the burn plan to understand smoke issues for each burn. Read the burn unit's smoke management plan if one was prepared.

In most cases, the Data-RAM 2000 machine will also be used to monitor smoke. Procedures for use of this machine are covered in Appendix B of this document. A dichot machine owned by ADEQ is set up at the Tusayan Airport and is maintained by the Fire Effects Staff. This machine may also need to sample more frequently during a prescribed fire. Consult with Burn Boss. Machine instructions are in Appendix B of this document.

### RX-4: Fire Behavior observations

All monitors should receive instruction on how to measure flame length, flame zone depth, and rate of spread before taking these measurements on a fire. Record observations on the form. Try to take observations from a variety of locations to indicate fire behavior in different fuel types or on different slopes or aspects. Take photographs to match up with the observations, but don't just photograph the big

flames—document the range of conditions. Read the burn plan so you understand the prescription and inform Burn Boss if fire is not in prescription. Go back to a location where you did fire behavior observations and take another photo of the area when cool. If possible, take a photo a week later also. Comparable photos over time are good. Use rulers in close-up photographs of duff and litter consumption. Make maps of photo points that can be visited a few weeks or a year later and document azimuths.

## RX-5: Photographic Record Sheet

Photos provide some of the best documentation. For every roll of film you shoot, you must fill out a photo record sheet. Use slide film. Make sure the databack feature is "on" when using the camera and try to record the "time" photo taken from the clock on the back of the camera. This helps when sorting photos later because you can match the times rather than the description alone. Write descriptions as best you can on the form (Fire Behavior in PIPO, Column from Helibase, Smoke in Tusayan) and write down the azimuth of the photo when appropriate (it may not always matter). If you find a good photo point over the course of the day, draw a map to locate that point, record the azimuth, and call it something like, "Shoshone Photo Point 1". Then record this for the description on the photo record sheet during the rest of monitoring. This is especially helpful for smoke monitoring. Back at the office, this sheet gets put in the binder "Photo Record Sheets to Match with Photos". When developed photos come back, you just need to go to one binder to figure out which roll it could be.

## RX-6: Daily Prescribed Fire Monitoring Report

This form does not have to be completed in the field, but can be used for taking notes for the report to be typed at the office at the end of the day. There are sections to write narratives about weather, smoke observations, fuel consumption, effects on poles and overstory, and fire behavior. This form must be completed before leaving the office on the day of ignition. *Do not wait until the next day*. During multiple ignition days, events will run together and narratives will become less detailed. Attach the following items:

- A map with acreage of burned area for that day.
- All monitoring forms *except* photo record sheet
- A copy of the fire weather forecast request fax from Fire Dispatch.

Use the burn plan prescription or FMH-4 to fill in the "range of conditions" column for the prescription for the burn unit. Use the monitoring sheets to determine the range observed that day while monitoring. Explain any differences in the third column.

File the report in the binder for that burn project. Reports are filed in reverse chronological order and tabs are made to separate ignition dates. These reports may be compiled once the burn is completed, merging information from sampling machines and using photographs taken during the burn.

*The Burn Boss will need to fill out this report if there are no on-site fire monitors for an ignition day. It is imperative that if FMH plots are burned, there is corresponding fire behavior documentation.*

## ICS Unit Log

Fill out a unit log for each monitoring team to document major events. This often helps to jog your memory at the end of the day when it's time to write the Daily Prescribed Fire Monitoring Report.

## Spot Weather Forecast Request Form

This is a standard form provided by NOAA. Fill in the header before going to the field and give the information (a photocopy) to Fire Dispatch so you don't have to repeat all this information over the radio. Use a cell phone to relay this information to Fire Dispatch if possible. Start taking weather observations as early as possible, ½ hour apart, and get 3 observations before calling them in. Take them from different elevations if possible. Cloud types can be important to fire weather forecasters, so use a guide to identify cloud types and cloud cover. Fire Dispatch will call you back in the afternoon with the forecast. Be ready to write it down. Request a copy of the forecast when you get back to the office and include it with other monitoring forms. It is sometimes helpful to the forecaster if you take evening observations to use for the spot forecast the next day.

## GRCA Personnel Cost Tracking Form

In order to provide a reliable estimate of the cost of burning a unit, we need to fill these out after each shift and turn them in to the Prescribed Fire Specialist when the burn is complete. Every person needs to be responsible for filling these out completely. If the ignition will take a few days, each person can fill out a separate sheet and keep track for the duration of the burn. These sheets must be given to the Prescribed Fire Specialist at the end of an incident.

## FMH 2-A Forest Plot Burn Data Sheet

Use this form when monitoring a Fire Behavior Observation Circle (FBOC) on an FMH plot in a burn unit. If the unit is being burned with aerial ignition, you cannot monitor the plot, but need to do your best to estimate fire behavior conditions from similar areas around the fire perimeter using the RX-4. Before the plot is burned, set up the FBOCs using pink pin flags in a 10' circle around the beginning and end stakes of all Brown's transects. Make sure igniters do not "dump" extra fuel on the plots to make them burn. Observe fire behavior and fill out the form. Take photos. You will not be able to monitor all 8 FBOCs, but monitor as many as you can. Be prepared to ask the Ignition Specialist to hold while monitors are in the interior taking observations. Keep this information with the Daily Prescribed Fire Monitoring Report, and put a copy in the folder for that FMH plot. If an FMH plot was burned but no monitors were on-site, record the date of the burn in the FMH plot folder on the site visit page. Ensure the POST read is added to the plot board so the plot is visited later that year.

## RX-7 Final Prescribed Fire Monitoring Report

This report summarizes all the daily reports into a final document and is only prepared at the Prescribed Fire Manager's request. Attach maps of burn progression and summarize observed weather, smoke, and fire behavior. Also, summarize any special concerns noted during the burn. Include digital images when possible to illustrate weather, smoke, and fire behavior. Ideally, this should be completed as soon as possible after the burn unit is complete. It can be completed by the Prescribed Fire Manager, Prescribed Fire Specialist, Fire Effects Specialist, or Burn Boss.

### *Tasks Associated with Monitoring a WFURB Fire*

During a WFURB fire, monitors will likely be assigned to work directly under the Incident Commander or in the Operations section. Information will be documented as dictated by those in charge, but many forms used for monitoring prescribed fires can also be used for monitoring WFURB fires as needed. All documentation should be given to either the IC or the Fire Dispatch office at the end of every operational period to eventually be filed with other incident documents. Level 1 and 2 documentation for WFURB fires will not be kept in the fire effects office.

## ***Level 3 Monitoring: Immediate Post-fire Effects***

Level 3 monitoring includes reconnaissance, fire conditions, and immediate post-fire effects. Level 3 monitoring does not occur for WFURB fires—only prescribed fires. Immediate post-fire effects monitoring includes all monitoring done within 5 years of a fire. This level is where the majority of fire monitoring takes place at Grand Canyon National Park through data collection on permanent plots. Plot visits are tracked on an Excel spreadsheet. The Master FMH Plot Monitoring Table is too large to include in this document as a hard copy and is available on disk as an Excel 97 document.

### *Monitoring Types*

FMH-4 Monitoring Type Descriptions are located in Appendix C and specify monitoring objectives and desired future conditions. All data analysis for monitoring types and descriptions of the plot network are in the Annual Fire Monitoring Report compiled for March 1 each year.

### *Standard Methods*

Detailed methods are in the 1992 Western Region Fire Monitoring Handbook (National Park Service 1992) which is currently under revision. For different monitoring types, information is gathered in with different parameters but using the same methods. For example, seedlings are counted in a 10 x 25 meter area in some monitoring types and a 5x10 meter area in others. Specifications are noted in the Monitoring Type Description Sheets (FMH-4s) located in Appendix C. On every plot, information is gathered for overstory (diameter and condition), pole trees (diameter, height and condition), seedlings (height), fuels (woody, litter, and duff amounts), herbaceous presence (frequency and height), shrubs (frequency and condition). Metric units are used in monitoring, except for the dead and down woody fuels transects which are in English units. Eight different photographs are taken of each plot. Information on plot location and all plot data are kept in 3-ring binders in the Fire Effects Office on South Rim.

No control plots exist in the plot network. Control plots will not be funded by FIREPRO unless extreme cases warrant their installation. If there is a park-specific concern and a justified need for control plots, Intermountain Region will consider funding them. If GRCA fire and resource management staff decide to install control plots, a plan for keeping fire out of such plots will have to be determined.

Plot reads are tracked in an Excel 97 spreadsheet called “plot status.xls”. A copy of this spreadsheet is on the Fire Effects Specialist’s computer and on the fire effects crew computer. Each winter, the plot workload is projected for the next five years depending on changes to burn priorities. This must be done in consultation with the

Prescribed Fire Manager. Priorities for new plot installations are made and documented. The plot visits needed for the following summer can then be put on the plot board in the fire effects office, and all the field copies for those plots can be prepared.

To ensure monitoring occurs to specified standards at Grand Canyon National Park, checklists were developed in 1999. These checklists aid crewmembers in plot establishment and installation, plot reading, and data management. Copies of all checklists are in Appendix D.

Two practice plots were established on the Shoshone prescribed burn unit on the South Rim to be used annually as the first plot visit of the season. They are called SHOS 1 and SHOS 2. During the first week of work in summer, the crew can visit these two plots first and enter these data into the database for practice in Grand Canyon's methods.

### *Timing of Monitoring*

Monitoring permanent plots generally proceeds from the warmest to coolest ecosystems in the park. Plot re-reads and installs begin in pinyon-juniper ecosystems on the South Rim and the ponderosa pine ecosystems on the South Rim. Next, plot re-reads and installations occur in North Rim ponderosa pine forests. The North Rim provides only a limited opportunity to adequately sample herbaceous plants, and by early September most are dead or dormant. The meadows on the North Rim (which may have plots installed in 2000) should be read in August. Ponderosa pine with white fir encroachment and mixed conifer should also be read before mid-September. In some years there will be an enormous plot load in a 2-month window during July and August. It may be necessary to split the Grand Canyon fire effects crew up into two teams, or to ask for assistance from other Grand Canyon fire employees or monitors from other parks.

### *Recording Data*

There are numerous forms used for FMH plot monitoring. They are all available in their original formats in the 1992 Western Regional Fire Monitoring Handbook (National Park Service 1992). To lessen confusion and reduce recording errors, we have modified many of the data sheets to include methods specific to Grand Canyon and reminders for some methods. All of the modified sheets are available on the Fire Effects desktop computer and hard copies are stored in a folder labeled "Forms" in the Fire Effects office. Copies of these forms are at the end of this document in Appendix E.

### *Data Management and Quality Control*

All data are entered into the fmh.exe program on the Fire Effects desktop computer when crew is on the South Rim. When working on the North Rim, data can be entered in fmh.exe on any computer with the software installed, and appended to the desktop computer later. See the checklists in Appendix D for detailed information on data management.

The checklists are provided as a quality control guideline for data management. In addition to these checklists it is generally understood that all monitors are responsible for recording information accurately, entering information accurately, and avoiding plot trampling. Ultimately it is the responsibility of the Fire Effects Specialist to ensure the checks are taking place which ensure data quality. The Fire

Effects Specialist is also responsible for monitoring design and interpretation, scheduling plot visits so data are collected at the right time of year, and ensuring crews are properly trained. The Fire Effects Specialist may delegate these responsibilities to the fire effects staff.

## *Equipment*

### For the Field

All common field equipment is located in the Fire Effects Office. Two gray and green bins hold most equipment, including the plot pack. One bin is for field equipment used on every plot, and the other is for "extra" equipment that is brought in the vehicle and left there in case equipment fails in the field. Checklists are provided to ensure both are packed with the proper equipment. Additional equipment is located in the Fire Effects storage locker upstairs of the Fire Cache on the South Rim. Camera equipment and film is in a file cabinet in the Fire Effects Office.

### GPS

The Precision Lightweight GPS Receiver (PLGR) is kept in locked storage. The Fire Effects Specialist is the contact for use of the PLGR. It is not to be used by a non-government or volunteer employee under any circumstances and can never be left unattended or in an unlocked place. It also cannot be left unattended in a tent, a locked vehicle, or a locked hotel room. The PLGR is taken to all plot visits. To date, not all plots have had locations marked with the PLGR. In some cases, the PLGR has been used to mark the route into the plot. The PLGR can be downloaded to interface with ArcView.

### Herbarium Supplies

Plant press materials, plant books, and the working herbarium are located in the Fire Effects Office at a desk dedicated to herbarium work. There are a variety of plant slides available and CD-ROM field identification guides are under development. Instruction for proper collection, pressing, and mounting of specimens is provided at the herbarium work desk, including "Preparing Herbarium Specimens of Vascular Plants" (Smith 1971) for comprehensive instructions. Efforts are made to deposit good-quality specimens in the park's Herbarium.

## *Data Analysis*

Traditionally, data analysis is performed at the completion of each field season and reported in an annual report that must be given to a printer by mid-February for distribution March 1. Data analysis, for the most part, consists of graphs showing density over time with standard error bars. Tables show percent change for some variables. Most analyses are performed with a combination of the FMH Software and Excel 97. The FMH-4s guide data analysis with a customized data analysis section. For information on the current results of the Fire Monitoring Program, see the most recent Annual Fire Monitoring Report.

If statistical testing for significance is necessary, we will determine if data are normally distributed. If so, we can use paired t-tests to detect change. Other tests may also be appropriate. We will consult a statistician at Northern Arizona University if necessary. If statistical testing is necessary we should obtain appropriate statistical software.

Results may be presented at conferences and other special meetings. Results that both support and contradict published fire literature will be of special interest.

### *Level 4 Monitoring: Long-term Change*

Level 4 monitoring means continuing all Level 3 monitoring over an extended period and adding a statistically valid primary indicator of long-term change. This type of monitoring may alert fire managers to the potential misuse of fire in the ecosystem. As the Grand Canyon's plots continue to be monitored, analysis may suggest that some unpredicted change in the ecosystem is occurring. The fire effects staff will identify trends and make other resource managers aware of them. If necessary, control plots may be installed, or a research project may be established to investigate the trend further.

## Special Resource Management Concerns

There are seven federally threatened or endangered wildlife species found in Grand Canyon National Park. An additional species, the peregrine falcon, has recently been delisted, but during a five-year monitoring period this species is generally accorded "threatened" status by the U.S. Fish and Wildlife Service. There are also 21 park species on the Arizona Game and Fish Commission's List of Threatened Native Wildlife in Arizona. The park also provides habitat for 12 species that were formerly considered Federal Candidate Category 2 species.

Only three of the federally listed species, the Mexican spotted owl, bald eagle, and peregrine falcon are likely to be affected by fire management activities. All planned burns will have compliance analysis conducted by the park Wildlife Biologist prior to ignition. When unplanned ignitions occur, the Wildlife Biologist or a designated representative is contacted through a process determined with Fire Dispatch to discuss management strategies.

There are over 116 alien plant species known to exist within the park (National Park Service 1997). The Fire Effects Monitoring crew will analyze the herbaceous transects each year and, at the least, provide an appendix in the Annual Prescribed Fire Summary detailing herbaceous species data. If an alien species population is found on a fire monitoring plot, the Revegetation Crew at the GRCA Science Center will be notified.

There are 63 vegetation associations described for Grand Canyon National Park (Warren et al. 1982). Over 1,400 species of vascular plants have been collected, a diversity which is attributed to the great variety of natural habitats within an 8,000 foot elevational change (Phillips et al. 1982). There is only one endangered plant in the park, the sentry milk-vetch (National Park Service 1997, page 2-26). The sentry milk-vetch is known from two sites on the South Rim. One site of about 500 plants is protected by an enclosure, while the second site with two individuals is at a remote and seldom visited location. The species grows on limestone ledges between the canyon rim and the pinyon-juniper woodland. A second population on North Rim is considered to be an undescribed variety. Fire management activities are not likely to affect either varieties of this species. There are seven species of special concern, formerly known as

Category 2 species. Fire management activities may affect the populations of three of these species: Grand Canyon rose, Grand Canyon catchfly, and Tusayan flame-flower. The other four species of special concern are found at sites below the canyon rims, outside of burn units, in woodland, desertscrub, and riparian environments. Fire management activities would not be likely to affect these populations.

A number of historic and archaeological sites exist within the Park. Prior to any planned ignitions, compliance from the park Archaeologist is necessary. These compliance procedures take place within the burn plan approval process.

Finally, there is growing concern about the reintroduction of fire to ponderosa pine forests that have had an artificial decrease in the natural fire return interval because of fire suppression. When fires are ignited in stands that have unnaturally high fuel load accumulations and uncommonly thick ladder fuels, there may be an increased potential for killing a large percentage of overstory trees. Caution must be used to prevent the unnecessary loss of overstory ponderosa pines during planned ignitions. Overstory mortality is monitored in appropriate monitoring types at Grand Canyon. The goal is to not to exceed an average mortality of 20% within 5 years post-fire for ponderosa pine larger than 16 inches diameter at breast height (dbh). An overstory tree, by definition in the Fire Monitoring Handbook (NATIONAL PARK SERVICE 1992), is any tree greater than 15 cm dbh (6” dbh).

## Conclusion

Monitoring results are compiled after each field season and included in the Annual Prescribed Fire Report due annually on March 1. Results will also be presented at the annual Prescribed Fire and Resource Management meeting. Fire and resource managers will determine if the results of previous burns are acceptable, based on the goals stated in the FMH-4 Monitoring Type Description Sheets for each monitoring type. If monitoring results are not acceptable, or if resource needs change, changes to the burn program or burn objectives may be necessary. These changes might include some or all of the following: altering burning prescriptions or monitoring objectives; recognizing the need for a research project; or treating invasive species with alternate methods.

This monitoring plan will be reviewed annually by the fire and natural resource staffs and updated as necessary.

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# FMH-4 MONITORING TYPE DESCRIPTION SHEET
## Grand Canyon National Park

**Monitoring Type Code:** FPIED1D02

**Monitoring Type Name:** Great Basin Conifer Woodland

**Prepared by:** Duhnkrack, Schroeder, Kuenzi, Kaplan in 1991 and 1993

**Updated by:** Tonja Opperman and Ken Kerr

**Date:** December 18, 1999

## PHYSICAL DESCRIPTION

Located at 6400 to 7000 feet elevation on the South Rim with 0-20% slope, all aspects. Soils are shallow and loamy with gravelly consistency derived from Kaibab limestone. Bare, rocky areas are common.

## BIOLOGICAL DESCRIPTION

Ninety percent of overstory stems are pinyon pine and/or Utah juniper with ponderosa pine as an occasional overstory tree; absolute canopy cover is 20-60%. The understory is sparse with pole trees of same species as overstory except for an occasional Gambel oak. Shrubs include mormon tea, banana yucca, snakeweed, serviceberry, cliffrose, apache plume, and rabbitbrush. Herbaceous plants include bluegrass, paintbrush, blue grama, locoweed, lupine, and squirreltail. Combined cover for brush and herbs is <50%.

## REJECTION CRITERIA

***Large rock outcroppings or barren areas >20% of the plot; areas with anomalous vegetation, boundary fences; areas within 30 meters of roads, utility corridors, human-created trails, human-created clearings, or slash piles; areas within 10 meters of significant historic or prehistoric sites or transitional ecotones; areas burned within the past 10 years; areas with more than 3 overstory ponderosa pine trees or >10% ponderosa pine cover; areas with >75% cover of either pinyon pine or Utah juniper.***

## DESIRED FUTURE CONDITION

This monitoring type is mainly located around the South Rim Village area and is being treated to reduce hazardous fuel conditions that could present an urban

interface problem. One goal for this monitoring type is to maintain the fuel load at a level that does not exceed 20 tons/acre. A second goal is to limit the overstory tree mortality to 20%, but at this time there has not been a comprehensive literature search to determine what a realistic overstory density goal should be. A study in northern Arizona suggests an average of 360 trees/ha (145 trees/acre) (Klopatek 1986) on 3 plots. This monitoring type is not burned with a true underburn in many instances, but is instead pile burned due to concerns around developed areas.

**BURN PRESCRIPTION**

Units will be burned during the monsoon season or from September until May or until green-up using head, flanking, and backing fires as needed to meet burn objectives.

| Fire Prescription Elements | |
|---|---|
| RH = 20-50% | Live Fuel Moisture = 60-120% |
| Dry Bulb = 50-90 F | Average Flame Length = 1-6 feet |
| Average Mid-flame Winds=0-7mph G15mph | Average Rate of Spread = 1-28 chs/hour |
| 10-hour TLFM = 6-12% | 1000-hour TLFM = 9-20% |

**MONITORING VARIABLES IN ORDER OF IMPORTANCE**

1. Fuel Loading

**PRESCRIBED FIRE PROJECT OBJECTIVES—First Entry Burn**

1. Reduce total average fuel load (including all woody material, litter, and duff) so as not to exceed 20 tons/acre (49 tons/ha). *Preburn fuel loads range from 6 to 26 tons per acre (15-64 tons/ha) on 5 plots.*
2. Limit overstory mortality of all species to an average of 20% within 5 years post-burn.

**FIRE MONITORING OBJECTIVES**

1. Install enough plots to sample total fuel load with 80% confidence that totals are within 20% of the true population mean.
2. Install enough plots to sample overstory tree density with 80% confidence that values are within 20% of the true population mean.

**DATA ANALYSIS**

See FMH-4 Data Analysis Checklist

**Literature Cited**

Klopatek, J.M. 1986. Nutrient patterns and succession in pinyon-juniper ecosystems of northern Arizona. In: Proceedings—pinyon-juniper conference. USDA Forest Service GTR-INT-215 pp 391-396.

## Plot Protocols for PIED

| GENERAL PROTOCOLS | | YES (√) | NO (√) | | YES (√) | NO (√) |
|---|---|---|---|---|---|---|
| **Preburn** | Control Plots/Opt | | √ | Herb Height/Rec | √ | |
| | Herbaceous Density/Opt | | √ | Abbreviated Tags | √ | |
| | OP/Origin Buried | | √ | Crown Intercept/Opt | | √ |
| | Voucher Specimens/Rec | √ | | Herb. Fuel Load/Opt | | √ |
| | Stereo Photography/Opt | | √ | Brush Individuals/Rec | √ | |
| | Belt Transect Width | 2 x 50 meters | | Stakes Installed: All | | |
| | Number of Belts recorded | 2 | | | | |
| | Herbaceous Data and Brush Data Collected at: Q4-Q1 and Q3-Q2 | | | | | |
| **Burn and Postburn** | Duff Moisture/Rec | | √ | Flame Zone Depth/Rec | √ | |
| | Herbaceous Data/ Opt | | √ | Herb. Fuel Load/Opt | | √ |
| | 100 Pt. Burn Severity/Opt | √ | | | | |

| FOREST PLOT PROTOCOLS | | YES (√) | NO (√) | | YES (√) | NO (√) |
|---|---|---|---|---|---|---|
| **Overstory**<br>Note: DRC on JUOS trees with multiple stems >2/tree. | Area sampled | 50 x 20 m | | Quarters Sampled | Q1,Q2,Q3,Q4 | |
| | Tree Damage/Rec | √ | | Crown Position/Rec | √ | |
| | Dead Tree Damage/Opt | | √ | Dead Crown Position/Opt | √ | |
| | | | | | | |
| **Pole-size** | Area Sampled | 25 X 20 m | | Quarters Sampled | Q1 & Q2 | |
| | Height/Rec | √ | | Poles Tagged/Rec | √ | |
| | | | | | | |
| **Seedling** | Area Sampled | 25 X 10 m | | Quarters Sampled | Q1 | |
| | Height/Rec | √ | | Seedlings Mapped/Opt | | √ |
| | | | | | | |
| **Fuel Load** | Sampling Plane Length | 100 feet | | Fuel Continuity/Opt | | √ |
| | Aerial Fuel Load/Opt | | √ | | | |
| | | | | | | |
| **Postburn** | Char Height/Rec | √ | | Mortality/Rec | √ | |

# FMH-4 MONITORING TYPE DESCRIPTION SHEET
# Grand Canyon National Park

**Monitoring Type Code:** FPIPO1D09

**Monitoring Type Name:** South Rim Ponderosa Pine

**Prepared by:** Tonja Opperman and Ken Kerr

**Date:** December 18, 1999, Updated 11/24/00

## PHYSICAL DESCRIPTION

***Located at 6000 to 7500 feet elevation on the South Rim on level to rolling terrain, including all aspects. Soils are moderately shallow with a silty loam texture. All are derived from Kaibab limestone parent material. Occasional barren rock outcrops.***

## BIOLOGICAL DESCRIPTION

***Total overstory[1] stems are 50-100% Pinus ponderosa. Pinus edulis, Juniperus osteosperma, and Quercus gambelli may be present. Absolute canopy cover is 20-60%. The understory is a mix of the same overstory species. Common shrubs include Artemisia tridentata, Gutierrezia sarothrae, and Cowania mexicana. Common herbaceous plants include Bouteloua gracilis, Poa fendlariana, and Lupinus spp.***

## REJECTION CRITERIA

***Large rock outcroppings or areas >20% of the plot with <10% ground cover; areas with anomalous vegetation, boundary fences; areas within 30 meters of roads, utility corridors, human-created trails, human-created clearings, or slash piles; areas burned within past 10 years; areas within 10 meters of significant historic or prehistoric sites or transitional ecotones. Areas with greatest amount of basal area contained in a species other than ponderosa pine.***

## DESIRED FUTURE CONDITION

At this time a literature search has been initiated to determine the desired future condition of ponderosa forests at Grand Canyon National Park, but it is not complete. Preliminary research suggests that there were anywhere from 14-18 overstory trees

[1] Overstory trees are defined in the Fire Monitoring program as trees with a diameter at breast height of 15 cm (6 in) or greater. This definition does not take individual tree dominance or crown position into account.

per acre (35-44 trees/ha) during pre-settlement and ponderosa pine comprised over 90% of the basal area, with the remainder occupied by pinyon, juniper, and Gambel oak (Covington 1994, Covington et al. 1998). Usually crown cover was less than 25% with trees clumped in groups of 2-44 individuals (Woolsey 1911, White 1985). All size classes were typically represented, but it was not a continuous pattern—trees were arranged in distinct size groups due to a number of decades between regeneration events (White 1985).
Frequent openings occurred, dominated by grasses and other herbaceous plants. Total fuel loads were typically 2 to 8 tons/acre (5-20 tons/ha) with averages estimated from 0.2 to 9.3 tons/acre (0.5-23 tons/ha) (Covington 1992, Covington 1994, Harrington and Sackett 1992). A postburn increase in fuel loads is acceptable after the initial prescribed fire treatments.

## BURN PRESCRIPTION

Units will be burned during the growing, transition, and dormant seasons with head, flanking, and backing fires as needed to meet burn objectives. Units may be burned at six-year intervals for up to three consecutive treatments or until a Desired Future Condition is met. Prescription element ranges and treatment objectives developed using past experience, BEHAVE program, and FOFEM program.

| Fire Prescription Elements | |
|---|---|
| RH = 10-80% | Live Fuel Moisture = n/a |
| Dry Bulb = 40-80 F | Average Flame Length = 1-10 feet |
| Average Mid-flame Winds=0-15mph G30mph | Average Rate of Spread = 1-40 chs/hour |
| 10-hour TLFM = 3-15% | 1000-hour TLFM = 9-25% |

### MONITORING VARIABLES IN ORDER OF IMPORTANCE

1. Overstory density
2. Fuel Load
3. Pole density

### PRESCRIBED FIRE PROJECT OBJECTIVES—First Entry Burn

**Immediately Post-Burn:**

1. Reduce total fuel load by at least 30% on average, as measured over the landscape immediately post-burn (fuel reduction efforts will continue until the Desired Future Condition of 0.2-9.3 tons/acre is achieved).
2. Limit crown scorch to 30% on *Pinus ponderosa* with dbh greater than or equal to 16” (40 cm).

**Two Years Post-Burn:**

1. Reduce *Pinus ponderosa* poles with dbh of 1-6 inches (2.5-15 cm) to average 0-200 trees/acre (0-494 trees/ha). *This is a conservative target and more research is needed to define a better pole density target; there are currently 0-730 poles/ac (0-1800 poles/ha) of* Pinus ponderosa *in this size class*.

## Five Years Post-Burn

1. Achieve and maintain a five-year post-burn density of 19-25 trees/acre of *Pinus ponderosa* in the 16"+ size class.

## PRESCRIBED FIRE PROJECT OBJECTIVES—Second Entry Burn

Objectives will be written for this section, once results from first entry burn are known.

## PRESCRIBED FIRE PROJECT OBJECTIVES—Third Entry Burn

Objectives will be written for this section, once results from first and second entry burns are known.

## FIRE MONITORING OBJECTIVES

1. Install enough plots to be 80% confident that overstory ponderosa pine density figures are within 20% of the true population mean.
2. Install enough plots to be 80% confident that total fuel load estimates are within 20% of the true population mean.
3. With less than 30 plots, estimate pole densities with the most confidence possible. At this time over 70 plots are needed to monitor poles due to a high variation in the preburn pole densities.

## DATA ANALYSIS

See FMH-4 Data Analysis Checklist

## Literature Cited

Covington, W.W. and M.M. Moore. 1992. Postsettlement changes in natural fire regimes: implications for restoration of old-growth ponderosa pine forest. *In* Old-growth forests in the Southwest and Rocky Mountain regions: proceedings of a workshop, p. 81-99. USDA For. Serv. Gen. Tech. Rep. RM-213. 201p.

Covington, W.W. and M.M. Moore. 1994. Southwestern ponderosa pine forest structure. J. For. 39-47.

Covington, W.W., M.M. Moore, P.Z. Fule, H.B. Smith. 1998. Grand Canyon Forest Ecosystem Restoration Report on Pre-treatment measurements of experimental blocks. Northern Arizona University unpublished manuscript.

Harrington M.G.and S.S. Sackett. 1992. Past and present fire influences on southwestern ponderosa pine old growth. *In* Old-growth forests in the

Southwest and Rocky Mountain regions: proceedings of a workshop, p. 81-99. USDA For. Serv. Gen. Tech. Rep. RM-213. 201p.

White, A.S. 1985. Presettlement regeneration patterns in a southwestern ponderosa pine stand. Ecology 66:589-94.

Woolsey, T.S. Jr. 1911. Western yellow pine in Arizona and New Mexico. USDA For. Serv. Bull. 101. 64pp.

## Plot Protocols for PIPO

| GENERAL PROTOCOLS | | YES (√) | NO (√) | | YES (√) | NO (√) |
|---|---|---|---|---|---|---|
| **Preburn** | Control Plots/Opt | | √ | Herb Height/Rec | √ | |
| | Herbaceous Density/Opt | | √ | Abbreviated Tags | √ | |
| | OP/Origin Buried | | √ | Crown Intercept/Opt | | √ |
| | Voucher Specimens/Rec | √ | | Herb. Fuel Load/Opt | | √ |
| | Stereo Photography/Opt | | √ | Brush Individuals/Rec | √ | |
| | Belt Transect Width | 2 x 50 meters | | Stakes Installed: All | | |
| | Number of Belts recorded | 2 | | | | |
| | Herbaceous Data and Brush Data Collected at: Q4-Q1 and Q3-Q2 | | | | | |
| **Burn and Postburn** | Duff Moisture/Rec | | √ | Flame Zone Depth/Rec | √ | |
| | Herbaceous Data/ Opt | | √ | Herb. Fuel Load/Opt | | √ |
| | 100 Pt. Burn Severity/Opt | √ | | | | |

| FOREST PLOT PROTOCOLS | | YES (√) | NO (√) | | YES (√) | NO (√) |
|---|---|---|---|---|---|---|
| **Overstory** | Area sampled | 50 x 20 m | | Quarters Sampled | Q1,Q2,Q3,Q4 | |
| Note: DRC for multiple-stemmed JUOS >2 stems/tree. | Tree Damage/Rec | √ | | Crown Position/Rec | √ | |
| | Dead Tree Damage/Opt | | √ | Dead Crown Position/Opt | √ | |
| | | | | | | |
| **Pole-size** | Area Sampled | 25 X 20 m | | Quarters Sampled | Q1 & Q2 | |
| | Height/Rec | √ | | Poles Tagged/Rec | √ | |
| | | | | | | |
| **Seedling** | Area Sampled | 25 X 10 m | | Quarters Sampled | Q1 | |
| | Height/Rec | √ | | Seedlings Mapped/Opt | | √ |
| | | | | | | |
| **Fuel Load** | Sampling Plane Length | 100 feet | | Fuel Continuity/Opt | | √ |
| | Aerial Fuel Load/Opt | | √ | | | |
| | | | | | | |
| **Postburn** | Char Height/Rec | √ | | Mortality/Rec | √ | |

# FMH-4 MONITORING TYPE DESCRIPTION SHEET
# Grand Canyon National Park

**Monitoring Type Code:** FPIPN1D09

**Monitoring Type Name:** North Rim Ponderosa Pine

**Prepared by:** Tonja Opperman and Ken Kerr

**Date:** December 18, 1999

## PHYSICAL DESCRIPTION

***Located at 6,900 to 8,900 feet elevation on the North Rim with slopes from 0% to 60%, including all aspects and depending on elevation. Soils are moderately shallow on ridgetops with silty loams occurring in drainage bottoms. All soils are derived from Kaibab limestone parent material.***

## BIOLOGICAL DESCRIPTION

Total canopy cover is at least 25%. *Pinus ponderosa* dominates the overstory[2], comprising at least 80% of overstory species. Other possible overstory species include occasional *Abies concolor*, *Populus tremuloides*, *Pseudotsuga menziesii*, and *Picea engelmanni*. The understory is composed of mostly (75% or more) *Pinus ponderosa* poles. Common brush species are *Robinia neomexicana*, *Berberis repens, Rosa fendleri*, and *Ceanothus fendleri*. Common herbaceous plants include *Achillia lanulosa, Carex* spp., *Poa fendleriana, Sitanion hystrix,* and *Viguiera multiflora.*

## REJECTION CRITERIA

***Large rock outcroppings or barren areas >20% of the plot; areas with anomalous vegetation, boundary fences; areas within 30 meters of roads, utility corridors, human-created trails, human-created clearings, or slash piles; areas within 10 meters of significant historic or prehistoric sites or transitional ecotones; areas burned in the last 10 years; areas with >20% overstory cover of trees other than ponderosa pine; areas with pole densities including >25% species other than ponderosa pine, and areas with >50% canopy cover of Robinia neomexicana.***

[2] Overstory trees are defined in the Fire Monitoring program as trees with a diameter at breast height of 15 cm (6 in) or greater. This definition does not take individual tree dominance or crown position into account.

## DESIRED FUTURE CONDITION

At this time a literature search has been initiated to determine the desired future condition of North Rim *Pinus ponderosa* at Grand Canyon National Park, but it is not complete. These forests were likely open stands with relatively few, large overstory trees, dominated by an herbaceous understory. Research suggests in one study that there were 56 *Pinus ponderosa* trees per acre (138 trees/ha) in North Rim *Pinus ponderosa* stands (Covington 1992), and in another study that there were 40-55 trees/acre (99-136 trees/ha) on the Kaibab Plateau during presettlement times. Pole-sized trees less than six inches in diameter (15 cm) were estimated to be in groups of 200-400 but no density figures are given (Rasmussen 1941). The fire frequency on the North Rim is estimated at 2 to 15 years for these elevations (Wolf and Mast 1998) but this study did not incorporate forests on the very southernmost parts of the plateaus. It is likely that the forests on the edges of the North Rim plateaus were less dense due to drier conditions and more frequent lightning-caused fires. Fuel loads ranged from 0.2 to 9.3 tons/acre (0.5-23 tons/ha) (Covington 1992). An increase in postburn fuel loads is acceptable after the initial prescribed fire treatments.

## BURN PRESCRIPTION

Units will be burned during the growing, dormant, and transition seasons from summer (June) to fall (November). In drier years the time period may move into April and/or December. The following values present a range of conditions that may be used to accomplish objectives. Optimal values and relationships exist between these ranges that relate to on-the-ground fire effects achieved as well as resistance to control. Prescription element ranges and objectives were developed using past experience, BEHAVE program, and FOFEM program.

| **Fire Prescription Elements** | |
|---|---|
| RH = 10-80% | Live Fuel Moisture = n/a |
| Dry Bulb = 40-80 F | Average Flame Length = 1-10 feet |
| Average Mid-flame Winds=0-15mph G30mph | Average Rate of Spread = 1-40 chs/hour |
| 10-hour TLFM = 3-15% | 1000-hour TLFM = 9-25% |

### MONITORING VARIABLES IN ORDER OF IMPORTANCE

1. Overstory density
2. Fuel Load
3. Pole density

## PRESCRIBED FIRE PROJECT OBJECTIVES—First Entry Burn

**Immediately Post-Burn:**

1. Reduce total fuel load by at least 30% on average, as measured over the landscape immediately post-burn (fuel reduction efforts will continue until the Desired Future Condition of 0.2-9.3 tons/acre is achieved).

2. Limit crown scorch to 30% on *Pinus ponderosa* with dbh greater than or equal to 16" (40 cm).

**Two Years Post-Burn:**

1. Reduce Pinus ponderosa poles with dbh of 1-6 inches (2.5-15 cm) to average 0-200 trees/acre (0-494 trees/ha). *This is a conservative target and more research is needed to define a better pole density target; Preburn pole densities range from 0-500* Pinus ponderosa *trees/acre (1235 trees/ha) and average of 51 trees/acre (126 trees/ha) in this monitoring type on 6 plots.*

## Five Years Post-Burn

1. Achieve and maintain a five-year post-burn density of 19-25 trees/acre of *Pinus ponderosa* in the 16"+ size class.

## PRESCRIBED FIRE PROJECT OBJECTIVES—Second Entry Burn

Objectives will be written for this section, once results from first entry burn are known.

## PRESCRIBED FIRE PROJECT OBJECTIVES—Third Entry Burn

Objectives will be written for this section, once results from first and second entry burns are known.

## FIRE MONITORING OBJECTIVES

1. Install enough plots to be 80% confident that overstory ponderosa pine density figures are within 20% of the true population mean.
2. Install enough plots to be 80% confident that total fuel load estimates are within 20% of the true population mean.
3. Install enough plots to be 80% confident that pole density estimates are within 20% of the true population mean.

## DATA ANALYSIS

See FMH-4 Data Analysis Checklist

## Literature Cited

Covington, W.W. and M.M. Moore. 1992. Postsettlement changes in natural fire regimes: implications for restoration of old-growth ponderosa pine forest. *In* Old-growth forests in the Southwest and Rocky Mountain regions:

proceedings of a workshop, p. 81-99. USDA For. Serv. Gen. Tech. Rep. RM-213. 201p.

Rasmussen, D.I. 1941. Biotic communities of Kaibab Plateau, Arizona. Ecol. Monogr. 11:229-76.

Wolf, J. and J. Mast. 1998. Fire history of mixed-conifer forests on the North Rim, Grand Canyon National Park, Arizona. Physical Geography, 19, 1, pp. 1-14.

## Plot Protocols for PIPN

| GENERAL PROTOCOLS | | YES (√) | NO (√) | | YES (√) | NO (√) |
|---|---|---|---|---|---|---|
| **Preburn** | Control Plots/Opt | | √ | Herb Height/Rec | √ | |
| | Herbaceous Density/Opt | | √ | Abbreviated Tags | √ | |
| | OP/Origin Buried | | √ | Crown Intercept/Opt | | √ |
| | Voucher Specimens/Rec | √ | | Herb. Fuel Load/Opt | | √ |
| | Stereo Photography/Opt | | √ | Brush Individuals/Rec | √ | |
| | Belt Transect Width | 2 x 50 meters | | Stakes Installed: All | | |
| | Number of Belts recorded | 2 | | | | |
| | Herbaceous Data and Brush Data Collected at: Q4-Q1 and Q3-Q2 | | | | | |
| **Burn and Postburn** | Duff Moisture/Rec | | √ | Flame Zone Depth/Rec | √ | |
| | Herbaceous Data/ Opt | | √ | Herb. Fuel Load/Opt | | √ |
| | 100 Pt. Burn Severity/Opt | √ | | | | |

| FOREST PLOT PROTOCOLS | | YES (√) | NO (√) | | YES (√) | NO (√) |
|---|---|---|---|---|---|---|
| **Overstory** | Area sampled | 50 x 20 m | | Quarters Sampled | Q1,Q2,Q3,Q4 | |
| | Tree Damage/Rec | √ | | Crown Position/Rec | √ | |
| | Dead Tree Damage/Opt | | √ | Dead Crown Position/Opt | √ | |
| | | | | | | |
| **Pole-size** | Area Sampled | 25 X 20 m | | Quarters Sampled | Q1 & Q2 | |
| | Height/Rec | √ | | Poles Tagged/Rec | √ | |
| | | | | | | |
| **Seedling** | Area Sampled | 25 X 10 m | | Quarters Sampled | Q1 | |
| | Height/Rec | √ | | Seedlings Mapped/Opt | | √ |
| | | | | | | |
| **Fuel Load** | Sampling Plane Length | 50 feet | | Fuel Continuity/Opt | | √ |
| | Aerial Fuel Load/Opt | | √ | | | |
| | | | | | | |
| **Postburn** | Char Height/Rec | √ | | Mortality/Rec | √ | |

**Rec = Recommended Opt = Optional**

# FMH-4 MONITORING TYPE DESCRIPTION SHEET
# Grand Canyon National Park

**Monitoring Type Code:** FPIAB1D09

**Monitoring Type Name:** Ponderosa Pine with White Fir Encroachment

**Prepared by:** Tonja Opperman and Ken Kerr

**Date:** December 18, 1999

## PHYSICAL DESCRIPTION

***Located at 8000 to 9000 feet elevation on the North Rim with slopes from 0% to 60%, including all aspects. Soils are moderately shallow on ridgetops with silty loams occurring in drainage bottoms. All soils are derived from Kaibab limestone parent material.***

## BIOLOGICAL DESCRIPTION

Total canopy cover is at least 25% but can near 100%. It is a mixed conifer forest dominated by *Pinus ponderosa, Abies concolor*, and *Populus tremuloides* with the greatest basal area in *Pinus ponderosa* even though there may be more overstory[3] *Abies concolor* stems per acre. Other possible overstory species include *Pseudotsuga menziesii*, *Picea pungens*, *Abies lasiocarpa,* and *Picea engelmanni*. The understory is composed of mostly *Abies concolor* (25 to 100%), *Pinus ponderosa, Populus tremuloides*, and *Pseudotsuga menziesii*. Common brush species are *Amelanchier utahensis*, *Berberis repens,* and *Robinia neomexicana.* Common herbaceous plants include *Bouteloua gracilis*, *Carex* spp., *Fragaria ovalis, Lotus utahensis, Pedicularis centranthera,* and *Poa fendleriana.*

## REJECTION CRITERIA

***Large rock outcroppings or barren areas >20% of the plot; areas with anomalous vegetation, boundary fences; areas within 30 meters of roads, utility corridors, human-created trails, human-created clearings, or slash piles; areas within 10 meters of significant historic or prehistoric sites or transitional ecotones; areas burned in the last 10 years; areas where majority of basal area is not in ponderosa pine; areas with pole densities that do not include white fir as a major component.***

[3] Overstory trees are defined in the Fire Monitoring program as trees with a diameter at breast height of 15 cm (6 in) or greater. This definition does not take individual tree dominance or crown position into account.

## DESIRED FUTURE CONDITION

At this time a literature search has been initiated to determine the desired future condition of North Rim *Pinus ponderosa* forests at Grand Canyon National Park, but it is not complete. Forests in the PIAB monitoring type are at a slightly higher elevation and experience slightly wetter conditions and cooler temperatures than the North Rim Ponderosa Pine (PIPN) monitoring type. *Pinus ponderosa* likely dominated these stands but occasionally other mixed conifer species were present as well as pockets of *Populus tremuloides*. At the 8200' elevation on the North Rim, research suggests the stands were comprised of 51 overstory *Pinus ponderosa* per acre (126 trees/ha) with a mixture of *Abies concolor* and *Populus tremuloides* equally occupying the remaining 40 overstory trees per acre (99 trees/ha) (Covington et. al. 1998). Fire likely occurred in these stands every 4-15 years (Wolf and Mast 1998). Pre-European settlement fuel load estimates are unknown, but are likely greater than the PIPN forest type to the south. A conservative estimate for desired average fuel load is 0.2 to 20 tons/acre, but this figure should be revised as new information is available. Pole density figures for this forest type are also unknown, but again, are likely to be more dense than the drier forests to the south.

## BURN PRESCRIPTION

Units will be burned during the growing and dormant seasons from summer (June) to fall (November). In drier years the time period may move into April and/or December. The following values present a range of conditions that may be used to accomplish objectives. Optimal values and relationships exist between these ranges that relate to on-the-ground fire effects achieved as well as resistance to control. Prescription element ranges and objectives were developed using past experience, BEHAVE program, and FOFEM program.

| **Fire Prescription Elements** | |
|---|---|
| RH = 10-80% | Live Woody Fuel Moisture = 60-250% |
| Dry Bulb = 40-80 F | Average Flame Length = 0.5 – 30 feet |
| Mid-flame Winds=0-15mph G30mph | Average Rate of Spread = 1-40 chs/hour |
| 10-hour TLFM = 3-15% | 1000-hour TLFM = 9-25% |

### MONITORING VARIABLES IN ORDER OF IMPORTANCE

1. Overstory density
2. Fuel Load
3. Pole density

## PRESCRIBED FIRE PROJECT OBJECTIVES—First Entry Burn

**Immediately Post-Burn:**

1. Reduce total fuel load by at least 30% on average, as measured across the landscape immediately post-burn (fuel reduction efforts will continue until the Desired Future condition of 0.2 to 20 tons/acre (average) is achieved).

2. Limit crown scorch to 30% on *Pinus ponderosa* with dbh greater than or equal to 16" (40 cm).

**Two Years Post-Burn:**

1. Reduce *Abies concolor* poles in 1-6" (2.5-15 cm) size class by 20-70% to average less than 100 trees/ac (247 trees/ha). *This is a conservative target until more research indicates a better target. Preburn* Abies concolor *pole densities average 237 trees/ac, and* Pinus ponderosa *poles average 31 trees/ac (77 trees/ha) in this monitoring type on 21 plots*.

## Five Years Post-Burn

1. Achieve and maintain a five-year post-burn density of 19-25 trees/acre of *Pinus ponderosa* in the 16"+ size class.

## PRESCRIBED FIRE PROJECT OBJECTIVES—Second Entry Burn

Objectives will be written for this section, once results from first entry burn are known.

## PRESCRIBED FIRE PROJECT OBJECTIVES—Third Entry Burn

Objectives will be written for this section, once results from first and second entry burns are known.

## FIRE MONITORING OBJECTIVES

1. Install enough plots to be 80% confident that overstory ponderosa pine density figures are within 20% of the true population mean.
2. Install enough plots to be 80% confident that total fuel load estimates are within 20% of the true population mean.
3. Install enough plots to be 80% confident that white fir pole density estimates are within 25% of the true population mean.

## DATA ANALYSIS

See FMH-4 Data Analysis Checklist

# Literature Cited

Covington, W.W., M.M. Moore, P.Z. Fule, H.B. Smith. 1998. Grand Canyon Forest Ecosystem Restoration Report on Pre-treatment measurements of experimental blocks. Northern Arizona University unpublished manuscript.

Wolf, J. and J. Mast. 1998. Fire history of mixed-conifer forests on the North Rim, Grand Canyon National Park, Arizona. Physical Geography, 19, 1, pp. 1-14.

## Plot Protocols for PIAB

| GENERAL PROTOCOLS | | YES (√) | NO (√) | | YES (√) | NO (√) |
|---|---|---|---|---|---|---|
| **Preburn** | Control Plots/Opt | | √ | Herb Height/Rec | √ | |
| | Herbaceous Density/Opt | | √ | Abbreviated Tags | √ | |
| | OP/Origin Buried | | √ | Crown Intercept/Opt | | √ |
| | Voucher Specimens/Rec | √ | | Herb. Fuel Load/Opt | | √ |
| | Stereo Photography/Opt | | √ | Brush Individuals/Rec | √ | |
| | Belt Transect Width | 2 x 50 meters | | Stakes Installed: All | | |
| | Number of Belts recorded | 2 | | | | |
| | Herbaceous Data and Brush Data Collected at: Q4-Q1 and Q3-Q2 | | | | | |
| **Burn and Postburn** | Duff Moisture/Rec | | √ | Flame Zone Depth/Rec | √ | |
| | Herbaceous Data/ Opt | | √ | Herb. Fuel Load/Opt | | √ |
| | 100 Pt. Burn Severity/Opt | √ | | | | |

| FOREST PLOT PROTOCOLS | | YES (√) | NO (√) | | YES (√) | NO (√) |
|---|---|---|---|---|---|---|
| **Overstory** | Area sampled | 50 x 20 m | | Quarters Sampled | Q1,Q2,Q3,Q4 | |
| | Tree Damage/Rec | √ | | Crown Position/Rec | √ | |
| | Dead Tree Damage/Opt | | √ | Dead Crown Position/Opt | √ | |
| | | | | | | |
| **Pole-size** | Area Sampled | 25 X 20 m | | Quarters Sampled | Q1 & Q2 | |
| | Height/Rec | √ | | Poles Tagged/Rec | √ | |
| | | | | | | |
| **Seedling** | Area Sampled | 5 X 10 m | | Quarters Sampled | Q1 | |
| | Height/Rec | √ | | Seedlings Mapped/Opt | | √ |
| | | | | | | |
| **Fuel Load** | Sampling Plane Length | 50 feet | | Fuel Continuity/Opt | | √ |
| | Aerial Fuel Load/Opt | | √ | | | |
| | | | | | | |
| **Postburn** | Char Height/Rec | √ | | Mortality/Rec | √ | |

Rec = RecommendedOpt = Optional

# Appendix G

# Pre-Attack Plan

# Grand Canyon National Park
# Pre-Attack Plan

This plan is under development. When completed, it will include the following considerations as outlined in the Pre- Attack Planning Checklist found in RM- 18, chapter 7:

**COMMAND**
Pre- attack WFSA (if appropriate)
Pre- positioning needs
Draft delegation of authority
Management constraints
Interagency agreements
Evacuation procedures
Structural protection needs
Closure procedures

**OPERATIONS**
Helispot, helibase locations
Flight routes, restrictions
Water sources
Control line locations
Natural barriers
Safety Zones
Staging area locations

**LOGISTICS**
ICP, base, camp locations
Road, trails (including limitations)
Utilities
Medical facilities Vegetation/fuel maps
Stores, restaurants, service stations
Transportation resources location
Rental equipment sources (by type)
Construction contractors
Sanitary facilities
Police, fire departments Land status
Communications (radio, telephone)
Sanitary landfills
Portable water sources
Maintenance facilities

**PLANNING**
Park base map
Topographic maps
Infrared imagery
Hazard locations (ground and aerial)
Archeological/cultural base map
Endangered species critical habitats
Sensitive plant populations
Special visitor use area

# Appendix H

# Long-Term Treatment Plans

# Grand Canyon Fire and Aviation Out-Year Fuels Treatment Plan

The out- year fuels management plan was developed to assist fire managers with setting short term and long term goals, as well as providing all park personnel with a long- term schedule of our fuels treatment priorities. This plan will remain a dynamic document that will see changes as national, regional, or park priorities change, and as fire use and wildland fire affect the landscape. Compliance with park archeologists and park biologists will also be a significant influence concerning future changes in this plan. We will be reviewing this document on an annual basis to ensure that it is current and still in line with fire management goals and direction.

Fire management staffs have developed a list of five prioritized goals to be considered while developing the out- year plan. The goals include:

1. Reducing the threat of wildland fire in the Wildland Urban Interface by moving forested areas currently listed as Condition Class 2 & 3 into Condition Class 1.
2. Improving forest conditions in areas currently determined to be in Condition Class 2 & 3 that are adjacent to significant natural and cultural resources or can promote the potential to manage fire under a wildland fire use strategy.
3. Moving forested areas currently listed as Condition Class 2 & 3 into Condition Class 1.
4. Maintaining areas within the Wildland Urban Interface that are currently in Condition Class 1.
5. Maintain current conditions in areas categorized as Condition Class 1.

This out- year plan will be evolving and changing on a yearly basis. As amendments or changes are made, a new plan will be made available for review.

# Long-term Treatment Schedule FY 2006 – FY2013

| WUI / HF | Fiscal Year | Project Name | Activity Type | Treat Type | Fuel Type | Fire Regime | Treat Number | Condition Class | Compliance Document | Target Acres |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| HF | FY05 | Grapevine | Treatment | Fire | PP | I | 2 | II | FMP | 864 |
| HF | FY05 | RX-300 | Treatment | Fire | PP | I | 1 | II | FMP | 391 |
| HF | FY05 | Shoshone | Treatment | Fire | PP | I | 2 | I | FMP | 650 |
| HF | FY05 | Walhalla- C. Final | Treatment | Fire | PP | I | 2 | II | FMP | 2279 |
| HF | FY05 | NW-1,3,5 | Treatment | Fire | PP | I | 1,2 | II, III | FMP | 2796 |
| WUI | FY05 | Srim Fuels Red. | Treatment | Manual | PJ | | 1 | | | 30 |
| WUI | FY05 | Nrim Fuels Reduction | Treatment | Manual | SF | | 1 | III | FMP | 30 |
| HF | FY05 | N. R. FireUse Slash Red | Treatment | Manual | MF | | 2 | | | 15 |
| | | | | | | | | | | *7055* |
| | | | | | | | | | | |
| WUI | FY06 | Long Jim I | Treatment | Fire | PP | I | 1 | III | | 1776 |
| WUI | FY06 | Long Jim II | Treatment | Fire | PP | I | 1 | III | FMP | 1656 |
| HF | FY06 | Walhalla- C. Royal | Treatment | Fire | PP | I | 2 | I | FMP | 2780 |
| HF | FY06 | Outlet | Treatment | Fire | PP | I | 2 | II | FMP | 1000 |
| HF | FY06 | Uncle Jim | Treatment | Fire | MF | II | 1 | III | FMP | 1475 |
| WUI | FY06 | Srim WUI Fuels Red. | Treatment | Manual | PJ | I | 1 | III | | 30 |
| HF | FY06 | Nrim Fuels Reduction | Treatment | Manual | SF | IV | 1 | III | FMP | 100 |
| | | | | | | | | | | *8817* |
| | | | | | | | | | | |
| WUI | FY07 | Tusayan | Treatment | Fire | PP | I | 2 | I | FMP | 584 |
| WUI | FY07 | Moqui | Treatment | Fire | PP | I | 2 | II | FMP | 744 |
| WUI | FY07 | Grandview | Treatment | Fire | PP | 1 | 2 | III | FMP | 1874 |
| WUI | FY07 | Hearst | Treatment | Fire | PP | 1 | 1 | III | FMP | 860 |
| HF | FY07 | Walhalla- Neck | Treatment | Fire | MF | I | 1 | III | FMP | 1000 |
| HF | FY07 | Roost - sw of poplar | | | MF | | 1 | III | FMP | 1800 |
| HF | FY07 | Srim WUI Fuels Red. | Treatment | Manual | PJ | I | 1 | III | FMP | 50 |
| HF | FY07 | Range Roost Prep | Treatment | Manual | SF | IV | 1 | III | FMP | 75 |
| | | | | | | | | | | 6987 |

| WUI / HF | Fiscal Year | Project Name | Activity Type | Treat Type | Fuel Type | Fire Regime | Treat Number | Condition Class | Compliance Document | Target Acres |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| HF | FY08 | Lonetree | Treatment | Fire | PP | I | 2 | I | FMP | 928 |
| WUI | FY08 | Picnic | Treatment | Fire | PP | 1 | 3 | I, III | FMP | 221 |
| HF | FY08 | Walhalla - Mathes Pt. | Treatment | Fire | PP | I | 2,3 | II | FMP | 1500 |
| HF | FY08 | Walla Valley | Treatment | Fire | PP | II | 2 | I, III | | 2700 |
| HF | Fy08 | Range, Roost | Treatment | Fire | MF | | 1 | III | FMP | 1500 |
| WUI | FY08 | Srim WUI Fuels Red. | Treatment | Manual | | I | 1 | III | | 50 |
| HF | FY08 | Nriim Fuels Reduction | Treatment | Manual | SF | IV | 1 | II | | 50 |
| | | | | | | | | | | *6949* |
| | | | | | | | | | | |
| HF | FY09 | Bugglen | Treatment | Fire | PP | I | 1 | II, lll | | 328 |
| WUI | FY09 | Entrance | Treatment | Fire | PP | 1 | 3 | I | | 690 |
| WUI | FY09 | Quarry | Treatment | Fire | PP | 1 | 3 | I | | 322 |
| HF | FY09 | Walla Valley | Treatment | Fire | PP | I | 2 | II | | 3500 |
| HF | FY08 | Outlet | Treatment | Fire | PP | I | 2 | II | | 2000 |
| HF | FY09 | Thompson - N boundary | Treatment | Fire | SF | IV | 1 | I | | 2000 |
| WUI | FY09 | Srim WUI Fuels Red. | Treatment | Manual | | I | 1 | III | | 50 |
| HF | FY09 | Nrim Fuels Reduction | Treatment | Manual | | IV | 1 | II | | 50 |
| | | | | | | | | | | *8890* |
| | | | | | | | | | | |
| WUI | FY10 | Long Jim III | Treatment | Fire | PP | I | 2 | II | | 1618 |
| WUI | FY10 | Sewage | Treatment | Fire | PP | I | 1 | II | | 1300 |
| HF | FY10 | Outlet | Treatment | Fire | PP | I | 2 | II | | 2000 |
| HF | FY10 | Hance | Treatment | Fire | PP | I | 3 | II | | 2838 |
| HF | FY10 | Watson | Treatment | Fire | PP | I | 3 | II | | 338 |
| WUI | FY10 | Srim WUI Fuels Red. | Treatment | Manual | | I | 1 | III | | 50 |
| HF | FY10 | Nrim Fuels Reduction | Treatment | Manual | | IV | 1 | II | | 50 |
| | | | | | | | | | | *8194* |

| WUI or HF | Fiscal Year | Project Name | Activity Type | Treat Type | Fuel Type | Fire Regime | Treat Number | Condition Class | Compliance Document | Target Acres |
|---|---|---|---|---|---|---|---|---|---|---|
| WUI | FY11 | Horsethief | Treatment | Fire | PP | I | 3 | I | | 500 |
| HF | FY11 | Grapevine | Treatment | Fire | PP | I | 3 | I | | 864 |
| HF | FY11 | RX-300 | Treatment | Fire | PP | I | 2 | I | | 391 |
| HF | FY11 | Shoshone | Treatment | Fire | PP | I | 3 | I | | 1090 |
| HF | FY11 | Walhalla - vista | Treatment | Fire | PP | I | 2 | II | | 3200 |
| HF | FY11 | Outlet | Treatment | Fire | PP | I | 2 | II | | 1000 |
| HF | FY11 | Boundary | Treatment | Fire | MF | IV | 1 | II | | 1000 |
| WUI | FY11 | Srim WUI Fuels Red. | Treatment | Manual | | I | 1 | III | | 50 |
| HF | FY11 | Nrim Fuels Reduction | Treatment | Manual | | IV | 1 | II | | 50 |
| | | | | | | | | | | *8145* |
| | | | | | | | | | | |
| WUI | FY12 | Long Jim I | Treatment | Fire | PP | I | 2 | II | | 1618 |
| WUI | FY12 | Picnic | Treatment | Fire | PP | I | 3 | I | | 221 |
| WUI | FY12 | Entrance | Treatment | Fire | PP | I | 3 | I | | 690 |
| WUI | FY12 | Quary | Treatment | Fire | PP | I | 3 | I | | 322 |
| HF | FY12 | Walhalla- Manz Point | Treatment | Fire | PP | I | 2,3 | I | | 3200 |
| HF | FY12 | Outlet- Widfross | Treatment | Fire | PP | I | 2 | I | | 1000 |
| WUI | FY12 | Srim WUI Fuels Red. | Treatment | Manual | | I | 1 | III | | 50 |
| HF | FY12 | Nrim Fuels Reduction | Treatment | Manual | | IV | 1 | II | | 50 |
| | | | | | | | | | | *7151* |
| | | | | | | | | | | |
| WUI | FY13 | Long Jim II | Treatment | Fire | PP | 1 | 2 | | | 1656 |
| WUI | FY13 | Topeka | Treatment | Fire | PP | 1 | 4 | 1 | | 2124 |
| WUI | FY13 | Uncle Jim | Treatment | Fire | MF | II | 2 | | | 1500 |
| WUI | FY13 | Srim WUI Fuels Red. | Treatment | Manual | | I | 1 | | | 50 |
| HF | FY13 | Nrim Fuels Reduction | Treatment | Manual | | IV | 1 | | | 50 |
| | | | | | | | | | | 5380 |

# Appendix I

# Fire Prevention Plan

# Grand Canyon National Park
# Fire Prevention Activities

Grand Canyon National Park does not have a formal fire prevention plan in place. Various prevention activities are implemented annually. These actions generally correspond with area Preparedness Levels. Actions are listed at the lowest preparedness level to which they apply.

**Preparedness Level 1 – low fire danger actions:**

- Ongoing – NPS participation on the AICG Arizona Firewise committee. This group provides a statewide Firewise educational message through the development and distribution of educational materials, a web site, interpretive signs, billboards, community workshops.
- IOF is involved with media outreach to discuss fire danger outlook for the upcoming season.
- Fire Information phone line (638- 7819) maintains a recorded message throughout the year.
- IOF attends monthly community meetings, fire update contains a safety message when appropriate.

**Preparedness Level 2 – moderate fire danger actions:**

- Defensible Space letter is mailed to all Grand Canyon box- holders.
- Local newspaper published defensible space article.

**Preparedness Level 3 – high fire danger actions:**

**Preparedness Level 4 – very high fire danger actions:**

- Additional Information Officers are ordered to increase public outreach activities and fire prevention programs.
- Printed materials containing an appropriate fire prevention message, including table tents, site bulletins, and shuttle bus signs are distributed park- wide, and throughout surrounding communities.
- NPS is a partner on Interagency Fire Prevention Team, which includes media campaigns to enhance public awareness and solicit support.
- GRCA Interpreters are asked to provide appropriate fire safety message at all interpretive programs.
- Prevention information is posted on park web site, as needed.

**Preparedness Level 5 – extreme fire danger actions:**

- News releases discussing fire danger are distributed frequently.
- Radio interviews are provided.
- Fire prevention materials designed, printed and distributed.
- Smokey Bear fire prevention materials are ordered from the Fire Prevention Catalog cache from the Cooperative Forest Fire Prevention Program in Grand Rapids, Minnesota, with severity funding.
- Fire prevention signs and flyers are posted throughout park and surrounding communities
- Public Service Announcements (PSAs) are developed and distributed to surrounding stations and (functional) park TIS stations.
- Additional Information Officers are ordered to provide assistance with fire prevention programs, including school presentations, civic groups, etc.
- A phone center may be established to provide public information on closures and restrictions.

# Appendix J

# Rental Equipment Agreements and Contracts (Supply Plan)

# AZ-GCP Fire & Aviation Supply Plan 2005 Contractors

* **New Vendors OR uncertain if EERA is on file**

## North Rim

*Port-a-Johns and Hand Washing Units*

-**A.S.Z. Johnson Enterprises, Inc.**
PO Box 1206
Fredonia, AZ 86022
928-643-7625
928-643-7510
contact: Ammon L. Johnson

-**George P. McCormick**
PO Box 519
Fredonia, AZ 86022
928-643-7302
435-689-0456
contact: George McCormick

*Showers*

-**A.S.Z. Johnson Enterprises, Inc.**
PO Box 1206
Fredonia, AZ 86022
928-643-7625
928-643-7510
contact: Ammon L. Johnson

***El Dorado Water & Shower Service, Inc. (National Contract)**
P.O. Box 944
6526 Mother Lode Dr
Placerville, CA 95667
888-622-8995
530-291-9911 (pager)
contact: Robert Williams

*CWN Caterer*

-**Houston's Trail's End, Inc.**
116 W. Kanab Creek Drive
Kanab, UT 84741
435-644-2488
contact: Joe Houston

# AZ-GCP Fire & Aviation Supply Plan 2005

## North Rim con't

*Potable Water Tenders*

-**H20 to Go, DBA Suzie Q. Inc.**
VXP 031130172
PO Box 91, 335 E 800 S
Kanab, UT 84741
435-644-5763
contact: Susan Markham

-**Dennis MacDonald**
818 South Hwy 89A
Kanab, UT 84741
435.644.5556
435-689-5556
contact: Dennis or Pam MacDonald

*Incident Office Trailer, Helibase Trailer, and Generator*

-**A. L. Brinkoetter**
2170 Northern Ave. Suite B#26
Kingman, AZ 86401
1-800-879-0068

*Fuel Tenders*

-**Tri Valley Distributing**
501 North Bluff St.
St. George, UT 84770
435-628-0451
contact: Clayton Cook

-**KB Oil**
336 N 100 W
Cedar City, UT 84720
435-586-2411
contact: Reed Rowley

*Office Support*

-**Preston Copier & Fax**
1509 S. 270 East #4
St. George, UT
435-673-7677 contact: Richard Preston/Peter Sudwick

# Supply Plan 2005

## North Rim con't

*Auto Parts and Service*

*__NAPA Auto Parts__
115 S 100
Kanab, UT
435-644-2526

*__Kanab Tire Center__
265 E 300
Kanab, UT
435.644.2557
1-888-949-2557

*__Judd Auto Service (towing)__
623 S. Main
Fredonia, UT
928-643-7128

-__Lane Little Livestock (heavy equipment – shop truck)__
635 S. 175 East
Kanab, UT 84741
435-644-5420
contact: Lane Little

-__Larry N. Reidhead Trucking, Inc. (heavy equipment – shop truck)__
PO Box 98
Fredonia, AZ 86022
928-543-7218
contact: Larry Reidhead

*Ice*

*__Reddy Ice Inc.__
P.O. Box 965
2018 Frontage Rd.
Page, AZ 86040
928-645-8886
928-660-0617 (cell)
contact: Marsha

# AZ-GCP Fire & Aviation

# Supply Plan 2005

## North Rim con't

*Non-potable Water Tenders*

-**Lane Little Livestock**
635 S. 175 East
Kanab, UT 84741
435-644-5420
contact: Lane Little

-**Dennis MacDonald**
818 South Hwy 89A
Kanab, UT 84741
435-644-5556
435-689-5556
contact: Dennis or Pam MacDonald

-**R&W Excavating**
VXP 990690973
PO Box 840830
Hilldale, UT 84784-0830
contact: Willie Jessop

*Groceries & Bottled Water*

*__Honey's Jubilee Foods__
260 E. 300 St
Kanab, UT
435-644-5877

*Lumber*

*__Page Lumber and Supply__
2050 Industrial Dr.
Page, AZ
928-645-8893

*__Lumber Plus Home Center and Builders Supply__
227 E 300
Kanab, UT
435-644-2779

# AZ-GCP Fire & Aviation Supply Plan 2005

# North Rim con't

*Paramedics*

*__Wilderness Medics, Inc.__
PO Box 86281
Phoenix, AZ 85080-6281
602-787-3909
Contact: Jack Spears

*__Paramedics Unlimited__
610 Bell Road, Suite #2
Mailbox 374
Phoenix, AZ 85022-2393
602-253-0549
contact: Steve Epinoza

*__Guardian Medical Transport__
PO Box 1905
Flagstaff, AZ 86002
888-299-2145
928-299-2145
contact: Mark Venuti

***Classic Lifeguard (Air Ambulance)**
800-444-9223

***Kane County Hospital**
355 N. Main St.
Kanab, UT 84741
435-644-5811

***Kane County Clinic**
355 N. Main St.
Kanab, UT 84741
435-644-4100

***Dixie Regional Medical Center**
River Road Campus
1380 E. Medical Center Dr.
St. George, UT 84790
435-251-1000

400 East Campus
544 S. 400 East St.
St. George, UT 84770
435-251-1000

***Page Hospital**
501 N. Navajo Dr.
Page, AZ 86040
928-645-2424

*Meals*

*__Employee Dining Room (EDR) – Xanterra__
928-638-2631 (switchboard)

contact: Don Botta or Manager on Duty

# AZ-GCP Fire & Aviation Supply Plan 2005

## North Rim con't

*Rental Vehicles*

*__Avis Rent-A-Car__
St. George Airport
St. George, UT
435-627-2002

*__Coleman's Exxon__
355 E. 300
South Kanab, UT 84741
435-644-2922

*__Speedy Rental__
355 E. 300
South Kanab, UT 84741
435-644-8300

*__Buggy Rent-a-Car (4X4s)__
12 N. Lake Powell Blvd
Page, AZ 86040
928-645-6664

contact: Russ

*Dumpsters*

*__PSI Waste Systems Inc.__
3004 Coppermine Rd
Page, AZ 86040
928-645-3885

contact: Mike McEntire or Donnalee Kerwin

# AZ-GCP Fire & Aviation Supply Plan 2005

## North Rim con't

*ATV rentals*

*__Buggy Rent-a-Car__
12 N. Lake Powell Blvd
Page, AZ 86040
928-645-6664
contact: Russ

*Saw Repair and Parts*

*__Page Honda (Stihl Powersaws)__
915 Coppermine Rd.
Page, AZ 86040
800-432-6923

**-Saw Guys (see attached EERA)**
4211 W. Highland
Redmond, OR 97756
877-923-3671 (shop)
541-419-3671 (cell)
contact: Joe or Aaron Russell

*Camper Services/Campgrounds*

*__Demotte & Jacob Lake Campgrounds (seasonal)__
contact North Kaibab District Office
928-643-8100

*LPG (Liquefied Propane Gas)*

*__Amerigas__
1719 S. Hwy 89A
Kanab, UT 84741
888-263-7442
435-644-2915

end North Rim list

**********
*****

# AZ-GCP Fire & Aviation Supply Plan 2005

## South Rim

*Port-a-Johns*

-**Sandoval's Sanitation, LLC**
3200 N. Fourth St.
Flagstaff, AZ 86004
928.526.0139
928.853.5818
contact: Stephen Sandoval

-**Waste Management**
2508 Flagstaff Ranch Road
Flagstaff, AZ 86001
928.699.4265
928.699.7546
contact: Juanita Davis

*Handwashing Units*

-**Waste Management**
2508 Flagstaff Ranch Road
Flagstaff, AZ 86001
928.699.4265
928.699.7546
contact: Juanita Davis

-**Robert Burk**
1403 Iron Springs Rd
Prescott, AZ 86301
928-445-0648
928-713-6924
contact: Robert Burk

*Signs*

*__United Rentals__
5301 East Gibson
Flagstaff, AZ 86001
928-526-1646 (24 hrs.)
contact: Phyllis or Kirk

# AZ-GCP Fire & Aviation Supply Plan 2005

## South Rim con't

*Showers*

***All States Fire Support**
P.O. Box 686
Lakeside, AZ 85928-0686
800-528-5013
*EERA pending
contact: Don or Coral Kane

-**A.S.Z. Johnson Enterprises, Inc.**
P.O. Box 1206
Fredonia, AZ 86022
928-643-7625
928-643-7510
contact: Ammon L. Johnson

*Dumpsters*

-**Waste Management**
2508 Flagstaff Ranch Road
Flagstaff, AZ 86001
928-699-4265
928-699-7546
contact: Juanita Davis

-**The Landscape Connection**
VXP990820248
5400 E. Empire
Flagstaff, AZ 86004
928-526-9052

*Ice and Bottled Water*

-**GMI – Fire Support Services**
PO Box 51715
Phoenix, AZ 85076
480-496-6864
928-600-0537
grhoffman@hotmail.com
contact: Greg Hoffman

AZ-GCP Fire & Aviation

# Supply Plan 2005

## South Rim con't

*Office Support*

-**Ikon Office Solutions**
2463 N. Walgreen, Suite B
Flagstaff, AZ 86004
480-379-7490 (Jenny)
480-379-7629 (Dan Miller)

*Potable Water Tenders*

-**L.A. Wright's Hauling**
6420 Townsend-Winona Rd
Flagstaff,AZ 86004
contact: ?

-**ABC Flagstaff Drinking Water**
HC 33, Box 435-A
Flagstaff, AZ 86004
928.699.8381
contact: Rick Richards

-**GMI – Fire Support Services**
PO Box 51715
Phoenix, AZ 85076
480.496.6864
928.600.0537
grhoffman@hotmail.com
contact: Greg Hoffman

-**Robert Burk**
1403 Iron Springs Rd
Prescott, AZ 86301
928.445.0648
928.713.6924
contact: Robert Burk

# AZ-GCP Fire & Aviation Supply Plan 2005

## South Rim con't

*Incident Office Trailer*

*__Fox Run (see attached EERA)__
P.O. Box 686
Lakeside, AZ 85929
928-368-5611
800-773-0435
928-242-3622 (cell)

contact: Dan Higgins

-**SOS Mobile Office**
14175 W Indian School Rd
Goodyear, AZ 85338
623-321-1977
contact: David Kohler

*Generators*

-**Robert Burk**
1403 Iron Springs Rd
Prescott, AZ 86301
928-445-0648
928-713-6924
contact: Robert Burk

*Fuel Tenders*

-**High Desert Investment Company**
504 E Butler
Flagstaff, AZ 86001
928-774-9111
contact: Allen Ribelin

# AZ-GCP Fire & Aviation Supply Plan 2005

South Rim con't

*Auto Parts and Service (shop truck)*

-**Mountain Truck and Trailer (heavy equipment)**
5385 N. Dodge
Flagstaff, AZ 86004
928-522-0400
contact: Chuck Brenden

-**Victor Neese Welding and Repair (light and heavy equipment)**
2608 W. Nicklaus Drive
Payson, AZ 85541
928-474-4104
928-978-1663
contact: Victor Neese

*__Golightly (tires and road service)__
3900 E. Huntington Dr.
Flagstaff, AZ 86004
928-526-2266
800-288-8473
928-607-5150 (cell)
contact: Brian Bachstein

*LPG (Liquefied Propane Gas)*

*__Graves Butane__
Grand Canyon, AZ
928-638-9295

*__Amerigas__
5375 N. Dodge Ave.
Flagstaff, AZ
928-526-0659

# AZ-GCP Fire & Aviation Supply Plan 2005

## South Rim con't

*Paramedics*

*__Wilderness Medics, Inc.__
PO Box 86281
Phoenix, AZ 85080-6281
602-787-3909
contact: Jack Spears

*__Paramedics Unlimited__
610 Bell Road, Suite #2
Mailbox 374
Phoenix, AZ 85022-2393
602-253-0549
contact: Steve Epinoza

*__Guardian Medical Transport__
PO Box 1905
Flagstaff, AZ 86002
888-299-2145
928-299-2145
contact: Mark Venuti

*__Flagstaff Medical Center__
1200 N. Beaver St.
Flagstaff, AZ 86001
928-779-3366

*__Grand Canyon Clinic__
1 Clinic Rd
Grand Canyon, AZ 86023
928-638-2551

*__Classic Lifeguard (Air Ambulance)__
800-444-9223

# AZ-GCP Fire & Aviation Supply Plan 2005

## South Rim con't

*Non-potable Water Tenders*

-**Aspect Fire LLC**
4415 N 61st St
Scottsdale, AZ 85251
928.636.8542
928.308.2052
contact: Charles Misfeldt

-**Hydrohaul LLC (no USFS EERA – NPS contract?)**
2400 West Whitetail Ln.
Williams, AZ 86046
928-607-1752
928-853-5146 (cell)
contact: Jim Schroeder

-**VCP, Inc**.
VXP 992280640
PO Box 2577
Flagstaff, AZ 86004
928.526.1683
928.220.2532
contact: Val Peavy

*__William Reisland__
VXP 001680102
7323 Kavanagh
Flagstaff, AZ 86004
928.527.1886
928.380.6343
contact: Bill Reisland

-**Blade Runner Heli-support**
PO Box 546
Ash Fork, AZ 86320
928.637.2375
928.699.1766
contact: Andy Hammond

# AZ-GCP Fire & Aviation Supply Plan 2005

## South Rim con't

*ATVs*

-**Jim Bedlion**

5400 E Horseshoe Way
Flagstaff, AZ 86004
928-526-5993
928-606-1788
contact: Jim Bedlion

-**Roger Hartley**
3406 E. Rt 66
Flagstaff, AZ 86004
928-526-1138
928-699-7851
contact: Roger Hailey

*Engines*

-**Aspect Fire LLC**
4415 N 61st St
Scottsdale, AZ 85251
928-636-8542
928-308-2052
contact: Charles Misfeldt

*Crash/Rescue Services*

***Ablaze Crash Rescue, INC. (see attached EERA)**
1217 Red Apple Road
Wenatchee, WA 98801
509-860-0731 (day & night)
contact: Tye Nelson

# AZ-GCP Fire & Aviation Supply Plan 2005

## South Rim con't

*Meals (BPAs)*

**-Café Tusayan**

928-638-2151

***We Cook Pizza & Pasta**
928-638-2278

***Yavapai Cafeteria (Xanterra)**
928-638-2631 (switchboard)

***Maswik Cafeteria (Xanterra)**
928-638-2631 (switchboard)

***South Rim General Store (Canyon Village Marketplace)**
928-638-2262

*Lodging*

**-Holiday Inn Express**
P.O. 3245 Highway 64
Grand Canyon, AZ 86023
928-638-3000
contact: Jay (ext. 801) or Elena (ext. 802)

**-Red Feather Inn**
P.O. Box 1460 Highway 64
Grand Canyon, AZ 86023
928-638-2414
contact: Linda (sales)

*CWN Caterer*

***Port-a-Pit (National Contract)**
24 E. Flores
Tuscon, AZ 85705
520-792-3145
contact: Gary Sneva

# Appendix K

# Emergency Stabilization and Burned Area Rehabilitation Plan

# BURNED AREA EMERGENCY REHABILITATION
(RM-18, chapter12)

## Introduction

On April 27, 1998, the Department of the Interior approved new policies for Burned Area Emergency Rehabilitation (BAER). These policies supersede and expand upon the interim policies contained in the draft Department of the Interior BAER Handbook, and establish consistent BAER guidelines among the NPS, BLM, BIA, FWS, and the USFS.

The new policies are a major step forward because they allow parks to expand the use of BAER funding to mitigate a broad range of threats to natural and cultural resources critical to our mission and protection mandates. Since BAER projects can have a major impact on many aspects of park management, the successful implementation of these policies requires a coordinated interdisciplinary effort among natural and cultural resource managers, fire managers, and visitor services.

## Policy Guidance

The following guidelines will be used to implement the policies contained in the DOI BAER Handbook:

1. BAER is an extension of EMERGENCY actions directly related to managing an unplanned wildland fire. This no- year funding is available to allow parks to take immediate actions to prevent unacceptable resource degradation and to minimize threats to life and property resulting from a fire. It is not designed to fund all future actions related to the effects of a fire, including repair of fire damaged facilities not presenting immediate life/safety hazards, long term monitoring, research of fire effects on sensitive species and ecosystems, or long term actions to control or eradicate invasive non- native species. Rather, it should be viewed as short- term funding authority available to mitigate immediate threats until the park can secure additional funding to address long- term needs.

2. BAER plans and funding requests must be submitted to regional offices within five (5) calendar days following control of a wildland fire. BAER plans shall follow the standard format as outlined in the draft DOI BAER Handbook, and will identify the cost of initial damage assessments and mitigation actions, and estimate the scope of follow- up phases of work expected to result from initial assessments. Initial damage assessments should be as thorough as possible so that critical mitigation work can be completed before damaging rainfall events occurs. Delayed assessments are inappropriate if a true emergency exists, and reduce the chances that mitigation treatments can be accomplished within the funding time constraints.

3. Regional offices shall review all park requests for BAER funding and approve/disapprove requests for up to $300,000 within seven (7) calendar days of receipt. Requests for more than $300,000 shall be forwarded to the Fire Management Program Center for review. The program center shall approve/disapprove such requests within seven (7) calendar days of receipt. If supplemental requests increase the total cost of BAER actions on a fire to more than $300,000,

the total request, including initial and supplemental phases, will be forwarded to the program center for review and approval/disapproval of all additional funds. Since planting trees with BAER funds is authorized as an experimental program at this time, those sections of BAER plans specifying tree planting must be approved by the program center, even though overall BAER plans can still be approved by regions if they fall under the $300,000 limit.

4. The National Park Service will continue to utilize the least intrusive and least resource damaging methods to manage wildland fire, and the least intrusive BAER actions required to mitigate actual or potential damage caused by wildland fire. In natural areas, natural recovery of native plant species will continue to be the preferred action, except in rare circumstances. Seeding or planting non- native or even native species produces unnatural changes in successional patterns and vegetative communities and should be used only as last resort to prevent erosion damage or to combat invasion of non native species.

5. It is not the intent of the BAER program to stop all erosion or eradicate all non- native species that may appear following fire. Erosion following wildland fire is an element of natural landscape change, and should not necessarily be viewed as a deleterious effect, especially in natural areas. For example, erosion should be reduced only when it threatens values to be protected, such as domestic water supply or critical cultural and natural resources, or where it is unnaturally severe due to unnatural changes in fire regimes. The BAER program should focus only on mitigating significant damage, not on eliminating all erosion or eradicating all non- native species from a fire area.

6. It is generally inappropriate to undertake BAER actions on wildland fires managed for resource benefits. When an agency administrator selects wildland fire use as an appropriate management strategy, it clearly implies that the fire can be managed to accomplish resource objectives. If fire behavior, effects and resource goals have been properly analyzed, the fire should generate no impacts that have to be mitigated. Those fires that are converted to suppression strategies will be treated as any other wildland fire suppression action and BAER may be appropriate. On wildland fires that are managed under both suppression and resource benefit strategies, BAER may be appropriate in areas where the fire was being suppressed.

7. Although Departmental policy permits fuels management project rehabilitation, the NPS views this as inappropriate, except in rare circumstances. Prescribed fires managed within prescription are designed to achieve resource benefits, and should not be conducted if they will result in resource damage or threats of resource damage. Regional offices will carefully review and approve/disapprove all proposals for fuels management project submitted as part of fuels management project funding requests. Funding for such actions is derived from hazard fuels reduction operations funds, not burned area emergency rehabilitation. Prescribed fires that exceed prescription and are suppressed may be appropriate for BAER.

8. Monitoring actions funded by BAER are restricted to assessments of whether treatments are effective and are maintained properly, and whether vegetative recovery in the absence of treatments is acceptable. Such monitoring will provide adaptive feedback into ongoing BAER projects and support program adjustments or supplemental actions to achieve protection goals. Long term monitoring of fire effects on sensitive species, cultural resources, or ecosystem function must be funded by research or resources management programs.

9. Cultural resource damage assessments and treatments are limited to those sites documented before the wildland fire occurred, and sites that are discovered incidentally while assessing and treating documented sites. BAER funds cannot be used to conduct systematic surveys of a burn area to document all sites that may have been exposed by the fire. Interim policies for cultural resource assessments and treatments developed during the Dome and Chapin #5 fires will be

reviewed by the Fire Management Program Center, with assistance from the National Cultural Resource Advisory Group, and standards will be incorporated into the BAER Handbook.

10. BAER Projects that are designed to mitigate significant impacts on cultural resources and which propose unusual or controversial treatments, or where the effectiveness of proposed treatments is unpredictable, are candidates to be reviewed by the Interagency National Cultural Resources Advisory Group. The decision to seek review and concurrence on such projects from this group may be made by the superintendent during the development of the original BAER plan, or during the regional or national approval process.

11. For NPS BAER projects, all mitigation actions must be completed within two years from the date the original BAER plan was approved. Additional time may be approved if it can be demonstrated that existing treatments have failed, or that it was impossible to install critical treatments within normal time frames. However, justifications must demonstrate that emergency conditions still exist. Under normal conditions, vegetation will recover sufficiently within two years to prevent significant erosion, check the invasion of non- native species, and stabilize ecosystem function. Extensions beyond the two- year limit must be approved through normal procedures, and cannot be granted beyond three years from the date of original BAER plan approval.

12. The emergency AD hiring authority can be used to support immediate mobilization of BAER resources for up to six weeks following a fire. After this time, normal- hiring procedures must be used.

13. For each BAER project, a park will prepare a final report that documents total funding approved and expended, treatment actions, and information on the effectiveness of treatments gathered from monitoring. The report will specify procedures for transition of any long term monitoring and continued maintenance of mitigation actions to normal park programs. The length and format of the report will be commensurate with the scope of the BAER project.

# Appendix L

# Compendium of Changes

05/20/2003

To: Superintendent
From: Fire Management Officer
Through: Deputy Superintendent
Chief Ranger
Subject: Annual Review of Fire Management Plan

The Grand Canyon National Park, **Fire Management Plan (FMP)** last updated in 1998 has been reviewed by the park staff. The review focused on meeting the requirements of the following documents and policy guidelines:

- **2001 Federal Wildland Fire Management Policy**
- **RM-18 (Version 3.0, November 5, 2002) CH 4**
- **D0-18**

An interdisciplinary team has been assembled and has commenced monthly meetings for the FMP and EIS. This group has reviewed a scope of service for contractor bids to develop an EIS for the FMP. A schedule for a Record of Decision on the preferred alternative of the EIS has been established for September 2004. This timeframe is consistant with Regional Director's memo for FMPs of Sept 11, 2002. The contract for the EIS should be awarded in the next several weeks.

The current plan is compliant with the relevant policy. The Environmental Assessment dated 1992 continues to reflect the complexity of the fire management operations as outlined in the existing plan.

Areas of update and revision to meet the above directives are noted below:

- **Appendix D** Joint Powers Operation Plan, has been revised and updated in the current plan and posted at dispatch.
- **Appendix E** The Northern Arizona Zone Charter was revised during the annual spring meeting and current copies are inserted in the plan and posted at dispatch.
- **Appendix F** Environmental Assessment was reviewed by park compliance officer and deemed acceptable with no alterations of current fire program operations which are suppression, wildland fire use and prescribed fire.
- **Appendix O** Recent Emergency Rental Agreements have been updated and revised. These revised records are located in the FPA office.
- **Appendix N** 10 year prescribed fire project schedule for 2002-2012 has been updated and entered into National Fuels Treatment and tracking program. Project documentation and maps are available at the Fire Management Office.
- **Appendix N** Burn Plans have been revised and follow current RM-18 Chapter 10 Prescribed fire directions.
- **Appendix N** Grand Canyon and Tusayon Smoke Management Plan was approved in 2001. This document is posted at dispatch.
- **Preparedness Plan** The Wildland Fire Preparedness Plan and Branch SOPs have been reviewed and updated. These documents are posted at dispatch.

The reviewed plan is available and can be forwarded upon request.

Please contact the Fire Management Officer, Dan Oltrogge at (928) 638-7822 if you have any questions.