SUMMARY OF THE

SEKI-YOSE SEQUOIA-MIXED CONIFER

PRESCRIBED FIRE WORKSHOP

Prepared by

Resources Management and Research Staffs

Sequoia and Kings Canyon and Yosemite National Parks

March 1986

I. INTRODUCTION

The workshop was held from January 7-9, 1986, at Sequoia and Kings Canyon National Parks. Those in attendance were: Dave Butts, Rod Norum, NPS BIFC; Bruce Kilgore, NPS WRO; Steve Botti, Jan van Wagtendonk, YOSE; Jack Davis, Dave Parsons, Dave Graber, Tom Stohlgren, Larry Bancroft, Tom Nichols, Marv Jensen, SEKI.

The purpose of the workshop was:

> to review and evaluate the status of the fire management program for the sequoia-mixed conifer forests of the Sierran Parks. Attention was given to evaluating the goal and objectives, prescribed burning techniques, and the types of monitoring required to evaluate the short and long-term effects and consequences of the program. Research needs were also identified.

Topics covered included:

A. Discussion of sequoia-mixed conifer prescribed fire goal and objectives for initial and subsequent prescribed burns. This includes the identification of areas where scene management instead of process management will be practiced and what the prescribed burning program would be in each case.

B. Evaluation of the FYRCYCL model. This model is currently being used in the ponderosa pine forests of YOSE, to help determine "natural" fire frequencies and fuel accumulations and thus when conditions become "unnatural", when prescribed burning is needed. The model's usefulness in predicting long-term changes caused by fire exclusion, and its potential applicability to other forest types were discussed. Other available conceptual and computer models also need to be evaluated for potential applicability.

C. Review of monitoring techniques used to document fire behavior as well as short and long-term fire effects, and the use of this data in using the FYRCYCL, or alternative models in evaluating the success of the fire management program.

D. Identification of research priorities to improve understanding of the natural fire process and its effects, develop standards against which to evaluate the success of program objectives, and acquire information necessary to maximize usefulness of available fire models.

II. GOAL AND OBJECTIVES

This section addresses the sequoia-mixed conifer forest prescribed fire management goal and objectives. Objectives are separated into three levels.

A. Goal

The consensus of the group was that to be consistent with NPS policy, the goal for this forest type should be to: restore or maintain the "natural" fire regime to the maximum extent possible so that natural ecosystems can operate essentially unimpaired by human interference. Fire regime can be defined as the systematic interaction of fire and biotic and physical environments within a specific land area. It includes the timing, number, spatial distribution, size, duration, behavior, return interval, and effects of natural fires.

Management strategy, then, should be process, rather than object, oriented. The latter strategy could be called the "museum" approach -- where it is considered more important to preserve 1) ecosystems as they occurred at some given point in time, 2) certain species or objects rather than entire ecosystems, or 3) aesthetically pleasing, manipulated landscapes rather than natural ecological scenes or environments. The use of such a strategy in this community is not supported by NPS policy.

Additional comments were that it is also not realistic to manage ecosystems as museums, and does not permit national parks to function as ecological reserves.

B. Objectives

1. Level One Objectives

Given the common agreement that natural fire should be restored to the sequoia-mixed conifer community, the most appropriate objectives at this first level are to:

a. Conduct research necessary to determine natural fire regimes, lightning strike frequency, input for fire spread models, and other studies as necessary to effectively implement the fire management program.

b. Identify those areas where wildfires threaten human life, property, or to leave the parks. Suppress and or contain fires in such areas.

c. Identify those areas, by priority, where natural ecosystems have been altered by human interference. Carefully use prescribed fire in such ecosystems where fire exclusion has created unacceptably high fuel loading. In such areas, limit the size and extent of the area to be manipulated (e.g., by prescribed burning or mechanical fuel removal).

d. Allow natural and some human-caused fires to burn in predetermined areas within prescription, provided they meet approved resource management objectives.

e. Maintain an active fire prevention program to reduce the incidence and threat of wildfire.

f. Take special precautions to preserve historical/cultural resources and threatened/endangered species.

g. Monitor and evaluate the effects of fire management on park ecosystems to further refine objectives. Use the results of the monitoring and evaluation to refine and adjust the fire management program.

Group discussion focused particularly on the definition of "unnatural fuel loading." Specific topics included:

(1) Indian Ignitions - It was commonly agreed that any fire history study will be complicated by Indian burning. Generally, the group felt that the record of Indian activity is too obscure to provide a basis for management. Also, it was recognized that not supplementing natural ignitions with Indian-like ignitions might extend fire-free intervals, and therefore increase intensity, relative to the past few hundred years. However, 2,136 lightning fires have occurred in YOSE since 1931, and over 1,300 lightning fires have been suppressed in SEKI since 1922, not including lightning fires occurring just outside the Parks. Computer simulation models will be used to assist in determining when additional ignitions are needed to replace suppressed natural fires that would have burned within the Park.

Group consensus was that except in special cases of "scene management" which involve the representation of the Indian era, natural fire frequency should not be augmented with fires designed to mimic Indian burning, nor should the Parks' ecosystems be locked into the Indian era.

(2) Unnatural Fuels

Research done over the years by Parsons, van Wagtendonk, Harvey, Hartesveldt, Bonnicksen, Rundel, Biswell, Kilgore, and others has indicated the need to conduct some prescribed burns to reverse the effects of fire suppression. A definition of the conditions which trigger this action, and which would indicate the need for subsequent burns, has been difficult to quantify.

Discussion focused on defining the terms "unnatural" and "unacceptable" fuels in terms of fuel load, vegetation characteristics, and fire behavior resulting from them. Further complicating these definitions is that high fuel loads can occur naturally on a local level, the result of aggregation breakup, wind throw, or insect infestations. Thus, the spatial distribution of these fuels, and means to inventory the fuel load, need to be assessed.

General consensus was that initial prescribed burns should be done when fuel loads are determined to be unacceptably high for whatever reason. Subsequent burning would be done only if the natural variability in fuel accumulation was exceeded as woody material accumulates from trees killed in the first burn. It is the identification of this "natural variability" that is difficult to quantify. Methods to identify this variability will be discussed in the Research and Monitoring Section.

In lieu of quantifiable standards for "unnatural" fuels, initial prescribed burns in this type are justified by the belief, in part supported by the literature, that fuels are to some extent unnatural since the last natural fire is beyond the range of the fire frequency of the past few hundred years. This argument is complicated by the unknown effect of the fire frequency of Indian ignitions. Initial burns have also been justified by the presence of a fire-intolerant understory which became established as Indian and natural fires became rarer at the close of the nineteenth century.

The history of restoration objectives in both Parks were discussed. Heavy thinning was done in the Mariposa and Redwood Mountain groves around 1970. Both programs were abandoned due to criticism about the appearance of the areas and concern that not every white fir in the understory was present due to fire suppression. Bonnicksen and Stone's data, for example, suggest that one-eighth of the Redwood Canyon area was dominated by seedling and sapling white fir aggregations in 1890.

Subsequently, both Parks developed prescriptions and techniques which allow local fuels, vegetation, microclimate and topography to determine fire effects. SEKI uses a spot fire, while YOSE uses a backing fire technique. Both types leave areas unburnt where fuels were light, and no effort is made to force fire into any areas.

Working definitions of "unnatural" fuels and justification for prescribed burning are, therefore, based upon continued refinement of objectives, use of computer models such as FYRCYCL together with the available literature and, monitoring of the relationship between fuels, vegetation, and fire behavior.

2. Level Two Objectives

Given the limitations on defining precisely "unnatural" fuels, the following general prescribed burning objectives were agreed upon:

a. Reduce heavy accumulation, both dead and down woody fuel and vertical ladder fuel with an initial prescribed burn.

b. Bring fuel loadings within the range of natural variability; if fuels reaccumulate beyond this range because of the effects of the first burn, subsequent prescribed burns will be conducted.

c. Prevent unacceptable impacts such as threats to visitor safety, damage to facilities, air quality deterioration, and unnaturally severe fires.

d. Use prescribed burns to replace natural fires that have been suppressed either by other agencies (i.e., natural fires that would have entered the park) or by the NPS because of constraints listed in (c).

e. Allow fuels to reaccumulate, and be burned naturally after atypical fuel levels have been reduced. Prescribed burning is a precautionary step necessary for the transition from a program of total fire control to the restoration of natural fire as an important ecological process.

3. Level Three Objectives

The group discussed the specific objectives of sequoia-mixed conifer prescribed burns and details of the management of the groves.

At this level a prescribed burn unit plan is filled out, approved by the Superintendent, and the program is carried out at a tactical level according to qualification and certification guidelines established by WRO. Specific results from monitoring, back to the first level objective are evaluated to justify either the inclusion of the treated area into the natural fire management zone, or to repeat the process leading to another prescribed burn.

The group agreed that the following specific objectives were appropriate for prescribed burns in sequoia-mixed conifer:

a. Reduce down and dead fuels (1 hr. 10 hr. 100 hr. and 1,000 hr) by 60-80 percent.

b. Keep overall scorch height to an average of about 30 feet.

c. Remove large concentrations of fuel from around the bases of sequoias with large fire scars before the burn. This would only be done on the initial prescribed burns, unless trees killed in the initial burn fell against the tree.

The above objectives would apply to both SEKI and YOSE prescribed burns in sequoia-mixed conifer.

The group discussed and reached concensus on the following:

(1) Showcase Areas

"Showcase areas" in Sequoia and Kings Canyon National Parks (SEKI) include the Congress Trail and Grant Tree walks, the perimeter of Crescent Meadow, and the Lost Grove area. These are believed to be adequate. If all of the heavily visited areas were "showcase", the public would miss opportunities to see a natural area and we would not be carrying out our primary mandate to preserve natural ecosystems. Since the four areas mentioned are the most heavily visited giant sequoia forest areas in SEKI, the visitor has ample opportunities to see sequoia managed for an unburned appearance. Managing large areas for appearance does not lend itself well to current natural resource policy, the spirit of the Leopold Report or Wilderness Act, or to reality. Yosemite (YOSE) also manages highly visible portions of its groves with a parallel notion of "aesthetics management". Existing "showcase" areas will have to be monitored since limiting the effects of fire (intensity, frequency, seasonality, etc.) in fire-evolved ecosystems may have far reaching consequences (i.e., root rot. disease and/or insect infestation.)

(2) Char Height

The attempt to specifically minimize char in non-showcase areas was felt to be too arbitrary. Scorch height and char height are closely related; it is not easy to allow a mosaic of fire effects to appear while trying to hold a lid on char height. It will be allowed to vary in pattern, as does the scorch height.

(3) Thinning

Prescribed fire, as opposed to heavy thinning with chainsaws and the physical removal of fuel throughout the forest, is the minimum tool to achieve the restoration of the forest to natural fire. There are many biological benefits derived by the presence of deep ash where concentrations of fuel burned, particularly the establishment of seedlings. The size of the groves, in SEKI, as well as the remoteness of most of them, do not allow access for the heavy thinning that was done in Calaveras Big Trees State Park and in the Mariposa Grove in YOSE. Moreover, any genotype difference in fire tolerance within species would be lost as trees were arbitrarily cut. Fire is more subtle in its thinning selection.

C. Conclusion

The goal, objectives, and techniques of the sequoia-mixed conifer prescribed fire management program were examined with regard to NPS fire management policy, the current body of scientific literature, and park resources management objectives. Although data needs (discussed below) were identified, particularly to determine when to conduct second and third burns and against which to better evaluate the long-term success of the program, the current program is compatible with policy and with the majority of the literature. The SEKI and YOSE programs have evolved along close parallel lines; techniques for applying fire in a patchy manner to allow a range of fire intensities are used in both parks.

II. RESEARCH AND MONITORING

The prescribed fire program has always been, and will continue to be, subject to change and refinement as information on fire behavior and effects is collected. Short and long-term monitoring provides this information and identifies research needs. The group recognized that monitoring procedures and research projects involving the giant sequoia-mixed conifer forest in SEKI and YOSE should be coordinated, and information shared by the Research and Resource Management staffs.

A. FYRCYCL MODEL

The questions of fire frequency, fire intensity, and fuel accumulation are basic to the understanding of fire's role in natural ecosystems. Computer simulation is one tool that can be used to help answer such questions. The FYRCYCL model can provide a short-term guide to help 1) determine the "natural" range of fuel levels for different vegetation types, 2) determine how many, if any, prescribed burns are required to bring fuels within the "natural" range, and 3) determine the appropriate range of intensities for those prescribed burns.

Considerable time was spent trying to define "natural" versus "unnatural" ranges of fuels. Group consensus was that large accumulations of fuel may not necessarily be "unnatural," since variations in fire frequency, fire pattern, and stand composition and age will influence local fuel loads. Current fire models can generate predicted fire intensity from measured fuel loads; what is less clear, then, is over how extensive an area should these fuels be found in order to classify the fuel levels as "unnatural".

The FYRCYCL Model is also currently tailored for the YOSE ponderosa pine type. Before it can be used for sequoia-mixed conifer, both parks must gather general and park specific data on fuel types, lightning fire frequency and location, stand structure and dynamics, fuel accumulation rates, and understory mortality rates. What will emerge from the development of the model for the sequoia-mixed conifer type will be a general overview of the relationship among the presence (or absence) of natural fire, fuel loads, and fire behavior. Together with fire spread models, it can also help identify what areas would have been burned had fires not been suppressed either inside or outside the Park. Such information would provide a guide for planning precribed burns to supplement future lightning-ignited fires.

It is recognized that the model's results will not take the place of experience and judgment in determining which areas should be prescribed burned, and how often. The FYRCYCL model is not designed to make objective decisions such as when to conduct a burn; it is limited by the accuracy of fuel inventories and other input variables, and the simplifying equations used to generate output. It will, however, provide another tool which, along with experience and intuition, will help managers make sound fire management decisions.

B. RESEARCH

Several areas of research were discussed in some detail.

First, inputs necessary to adopt the FYRCYCL model to sequoia-mixed conifer include:

1. Fuel Data by Size Class

2. Annual Increment Forest Growth Data

3. Stand Growth, Death, and Recruitment Rates

4. Relationship of Tree Age to Height

These four items are used to evaluate the amount of fuel available, and the rate at which it accumulates. Some of these data are available for sequoia-mixed conifer. Jan van Wagtendonk will coordinate the acquisition of additional data as needed.

5. Lightning Location Data

This can be obtained by use of the ALDS terminal (Automatic Lightning Detection System) which the Parks will have as a result of FIREPRO funds. Downstrike frequency and location will be mapped and archived.

6. Evaluate Fire Behavior Models

Computer simulation of the relationship of fuel dynamics and fire behavior requires the validation of the accuracy of the fire behavior models used. This can be done by monitoring fire weather and the behavior of actual fires and comparing observed behavior with predicted behavior.

7. Collate Historical Weather

The relationship between fuel dynamics and fire behavior is influenced by the historical patterns of weather. Large fires can be expected to occur during dry years, and the frequency of these years will influence the probability of large fires occurring in the Parks. The coincidence between occurrence of lightning and extreme fire weather will also influence fire behavior.

Responsibilities for the collection of these data are as follows: Jan van Wagtendonk will work with the SEKI staff to collect the kinds and quantity of information needed to tailor the model for

the sequoia-mixed conifer type. Lightning occurrence and fire weather is park specific. Validation of fire models can be done by either park, and the research staffs of both parks need to decide how much information is available, or needs to be collected, for items one through four.

8. Fire History

The other area of research which is needed involves the determination of fire history. Although Indian burning may complicate the data, an analysis of the fire record in scars and stumps, external natural ignition patterns, historical narratives of fires, and meadow cores will need to be evaluated to help determine the historic fire regime. Much of this work will depend on obtaining funds to do a detailed analysis of the biological fire record. This research will provide an important input in refining what the "natural" fire regime consists of and what management efforts will be most valuable in restoring it. This research will be coordinated by Dave Parsons, Research Scientist, SEKI.

C. MONITORING

The current fire monitoring program includes both short and long-term evaluation. Short-term monitoring measures the direct effects of a burn in meeting objectives, principally live and dead fuel reduction. Long-term monitoring tracks successional changes over time at established plots and relates those to fire behavior. Monitoring of natural fires in the backcountry provides information for the refinement of prescriptions and techniques used on prescribed burns.

The group felt that long-term monitoring of post burn plots should be done 1, 2, 3, 5, 10, and 20 years after a fire. While not every burn will have long-term plots, sufficient plots will be placed in the main vegetation types to produce an accurate picture of effects; perhaps six to 12 vegetation types, with 10 to 30 plots per type, would be adequate. Control plots will be included for each type.

Fire monitoring plots that were established in the 1960's and early 1970's need to be evaluated although they often do not have good data on fire weather and behavior.

Finally, a system of data management must be created. The monitoring data will be computerized so that analysis of variance can be done, which can determine the number of plots needed, and fire

effects can be documented. The SEKI and YOSE Research and Resources Management staffs will work together and discuss data collection techniques and draft a standard format. discuss this format with YOSE counterparts, working toward a basic standard method which can be tailored to meet any special needs the Parks may have.

To be fully effective, the monitoring program must provide the types of data necessary to help fine tune the management program. This feed-back will largely determine the success of the program. This will be the joint responsibilities of all those involved in the program.

III. CONCLUSION

The consensus of the group was that much progress has been made in the past few years in clarifying management direction and philosophy. The prescribed fire management program in sequoia-mixed conifer has evolved over the last 20 years, developing, modifying, and refining objectives and techniques as experience and information are gained. Future monitoring and research will ensure that the programs are based on the best information available, and that program refinements can be made based on such information. An annual meeting, such as this, would be very useful in facilitating this information exchange; it was interesting to learn that even without such meetings, the goal, objectives, and techniques of the YOSE and SEKI prescribed fire management programs have evolved along very similar lines.

Queries to the National Park Service

1. Most of the legislation that guides the management of national parks specifies that those parks must be maintained in a "natural condition". If the Park Service has failed to define "natural", how can it claim to be successful in restoring or maintaining "natural" conditions? How can success be measured without a standard of comparison?

2. Doesn't the Park Service have a legal responsibility to interpret the meaning of what is "natural" from its guiding legislation? Isn't it also necessary to make that definition precise enough (for each park) to insure that independent and objective scientists can reach the same conclusion when judging how successfully natural conditions have been restored? How can such precision be achieved without quantitative standards of naturalness?

3. If the Park Service selects "process" or "function" to define naturalness, what published scientific evidence can it produce to document that "process" or "function" is independent of the "structure" of an ecosystem? If structure and process are interdependent, which <u>is</u> documented in the scientific literature, then how can a standard of naturalness exclude structure?

4. What procedures will the Park Service follow to insure that alternative definitions and measures of "naturalness" will be fully explored, documented, and objectively evaluated by the scientific community, and the general public? When will a decision be reached? How will management practices be modified during the time when a decision is being formulated? Who will make the decision?

*Provided by Dr. Thomas M. Bonnicksen in response to a request from Eric K. Barnes in connection with the prescribed-fire management review (sequoia-mixed conifer forest), Sequoia-Kings Canyon and Yosemite National Parks, California, 1986.

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Department of
RECREATION AND PARKS

March 24, 1987

Ms. Michele Strutin, Senior Editor
National Park and Conservation Association
FEEDBACK
1015 Thirty-first St. NW
Washington, D.C. 20007

Dear Ms. Strutin:

The article entitled "Born of Fire," and NPCA's position statement on prescribed burning, in the Jan/Feb 87 issue advocate a policy that could jeopardize the integrity of our national parks. The NPS and NPCA advocate "process management" as opposed to "scene management" in the use of prescribed burning. This policy is scientifically naive. Structure and function (or scene and process) are inseparable interacting parts of an ecosystem. Therefore, a prescription that controls the location and behavior of a fire will produce a specific "scene." Because the NPS must, by law, maintain the parks in a "natural condition," the scene that burning produces must also be natural. What is missing is a scientifically defensible standard of naturalness that can be used to judge success. Thus, the NPCA is advocating a policy of naturalness by declaration. A policy that is based on blind faith! There are no refereed journal articles in the scientific literature which demonstrate that prescribed burning is producing natural conditions. Park Service managers and NPCA officials who advocate a policy based on blind faith are not living up to their responsiblities to present or future generations.

Sincerely,

Thomas M. Bonnicksen, Ph.D.
Professor and Head
Department of Recreation and Parks
Texas A&M University

P.S.

This letter is worded very carefully. If you edit it, please check with me before publication.

APPENDIX I

United States Department of the Interior

NATIONAL PARK SERVICE

WESTERN REGION

450 GOLDEN GATE AVENUE, BOX 36063

SAN FRANCISCO, CALIFORNIA 94102

IN REPLY REFER TO:

N27 (WR-RN)

April 29, 1986

Dr. Norman L. Christensen
Department of Botany
Duke University
Durham, N.C. 27706

Dear Dr. Christensen:

On behalf of the Western Region of the National Park Service, I would like to request your participation as part of a panel to review the prescribed fire program in the sequoia-mixed conifer forests at Sequoia, Kings Canyon, and Yosemite National Parks. As you are aware, prescribed fire has been used operationally in these parks since 1969 at Sequoia Kings Canyon and 1970 at Yosemite. These are two of the National Park Service's earliest programs aimed at restoring the natural role of fire to forest ecosystems.

The goal of the fire management program in the Sierran sequoia-mixed conifer forests of these parks is to maintain or restore natural fire regimes to the maximum extent possible so that ecosystems can function essentially unimpaired by human interference. This goal is based on NPS policy. Your panel will be asked to evaluate the effectiveness of the NPS fire management program in accomplishing the above goal. This will include an evaluation of the effectiveness of the objectives and operational aspects of the program.

We feel it is timely to conduct a review of the program to be certain this widely accepted practice is being carried out at the highest possible standards. It is imperative that this program be (1) ecologically sound and (2) economically feasible; we would also like it to be as responsive to aesthetic concerns as possible without compromising the overall objective.

With this as a given, I propose four objectives for your review panel:

1. Review the history and evaluate the current status of the fire management program for the sequoia-mixed conifer forests of SEKI and YOSE.

2. Evaluate the scientific basis for the program (with emphasis on giant sequoia groves).

3. Evaluate the impacts of prescribed as opposed to natural fire on individual giant sequoia and on sequoia groves, keeping in mind the imperative that any actions taken must be ecologically sound.

4. Prepare a preliminary report by July 31, 1986 summarizing your findings and recommendations involving:

   --Historical background, scientific basis, and current status of the program.

   --Evaluation of operational aspects of the program.

   --Recommendations about alternatives/options for future courses of action for the NPS at SEKI and YOSE involving implementation of the program.

We now plan a 2-day field review at Giant Forest in Sequoia National Park on June 30 and July 1, 1986. We want to coordinate the work of this panel with that field review; we would like the panel to spend July 2 reviewing the program in whatever ways you would find most productive. Park staff as well as a number of others interested in the program will be available for consultation at that time. Optional field trips will be available either before or after the meeting date. I have asked Dr. Bruce Kilgore, Chief of our Division of Natural Resources and Research to serve as advisor to the panel; he will be in touch with you to arrange the initial meeting and to assist you with logistics for your trip to Sequoia-Kings Canyon National Parks.

We look forward to hearing of your acceptance of this assignment and to working with you in achieving our common goals.

Sincerely,

W. Russell White

for Howard H. Chapman
Regional Director, Western Region