YOSE

YOSEMITE

NATURAL RESOURCES MANAGEMENT PLAN AND ENVIRONMENTAL ASSESSMENT

July 1982 Revision

YOSEMITE NATIONAL PARK
California

UNITED STATES DEPARTMENT OF THE INTERIOR / NATIONAL PARK SERVICE

YOSEMITE

NATURAL RESOURCES MANAGEMENT PLAN
AND
ENVIRONMENTAL ASSESSMENT

July 1982 Revision

YOSEMITE NATIONAL PARK
California

UNITED STATES DEPARTMENT OF THE INTERIOR / NATIONAL PARK SERVICE

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

YOSEMITE NATIONAL PARK

WESTERN REGION

The Yosemite National Park Natural Resources Management Plan and Environmental Assessment and its appended Management Program was completed and approved on December 9, 1977. This represents a March 1982 revision of those original documents. The management program presented in the subsequent pages of this document consists of an overview, new and revised project statements and environmental assessments, a list of references and programing sheets.

It was determined through public and National Park Service review of the 1977 Natural Resources Management Plan and Environmental Assessment that the proposed actions would not have significant environmental impact or adversely affect the cultural environment. Because all of the revised projects fall within the umbrella of the 1977 Environmental Assessment and comply with all relevant laws and regulations, no further consultation or documentation of impacts is necessary. In spite of that determination all project statements in the March 1982 revision were subjected to NEPA impact analysis and documentation. Therefore, no further consultation or documentation of impacts is necessary prior to project implementation.

Recommended: [signature] 4/2/82
Superintendent; Yosemite National Park — Date

Approved: Howard H. Chapman 7/6/82
Regional Director; Western Region — Date

TABLE OF CONTENTS

OVERVIEW

Yosemite National Park is situated in a region dominated by the Sierra Nevada. The Park's geological, biological, and scenic resources are exceptional in both type and quality. Since it was first visited by non-Indians in 1851, and set aside as a reserve in 1864, Yosemite has attracted more and more people--reaching a peak of 2.7 million visitors in 1981. To the visitor, the unique resources which comprise Yosemite seem much the same as they were 120 years ago. Nevertheless, the long-term effects of fire-suppression, visitor use, insect control, construction of facilities and varied management practices in and adjacent to the Park have brought about gradual change in the total Park environment. In certain areas, especially Yosemite Valley, the sequoia groves, the mixed-conifer forest, and some high elevation meadows, the ecological balance has been altered. In spite of the above, evidence indicates that the wildland portions of all ecosystems can be largely restored or maintained with implementation of sound management.

The objectives for resources managment are:

RESTORE AND MAINTAIN NATURAL TERRESTRIAL, AQUATIC, AND ATMOSPHERIC ECOSYSTEMS SO THEY MAY OPERATE ESSENTIALLY UNIMPAIRED.

Conduct continuing research to gather and analyze information necessary for managing natural resources.

Restore altered ecosystems as nearly as possible to conditions they would be in today had natural ecological processes not been disturbed.

Protect threatened and endangered plant and animal species and reintroduce, where practical, those eliminated from the natural ecosystems.

Identify and perpetuate all natural processes in Park ecosystems.

Permit only those types and levels of use or development that do not significantly impair Park natural resources, and direct development and use to environments least vulnerable to deterioration.

Limit unnatural sources of air, noise, visual and water pollution to the greatest degree possible.

PRESERVE, RESTORE OR PROTECT THE SIGNIFICANT CULTURAL RESOURCES (HISTORIC AND PREHISTORIC).

Identify, evaluate and determine the significance of cultural resources, encompassing buildings, structures, sites, and objects.

Provide for the preservation, restoration or protection of these significant cultural resources.

Permit only those uses which are compatible with the preservation of significant cultural resources.

Identification and recommendations for use and preservation of significant cultural resources will be covered in the Cultural Resources Management Plan. Objectives listed above that apply to cultural resources are pertinent to the Natural Resources Managment Plan only as they insure preservation of those resources.

Therefore, the primary objective of resources management will be the perpetuation of the natural processes which have had a dynamic influence on the development of the Park's ecosystems. This will be accomplished by restoring altered systems as nearly as possible to the conditions that they would be in today had ecological processes not been disturbed and, when practical, by reintroducing species which have been eliminated from the natural systems. In heavy use areas, such as Yosemite Valley and developed sites, additional management programs will be utilized to simulate natural processes, restore natural settings, and provide protection for the visiting public.

This, then, is a plan for the restoration and maintenance of the total environment rather than the piecemeal protection or management of selected features or species. As such, vegetation management represents the prime thrust of this plan, since vegetation, primarily a product of climate and soil, largely determines the composition and density of the dependent animal resources. As vegetative communities depart from the natural or pristine, so also are the animal resources altered.

All development and the use that Park ecosystems receive from both internal and external sources result in some departure from the natural state. Besides the immediate site, the affected area often includes a considerable portion of the surrounding environment. Adverse influences include the aesthetic impact of development on the wildland environment along with the physical and biological impacts of increased human use and that of support systems such as water, sanitation, solid waste collection, power, communications, and transportation. The above influences lead to changes in animal and plant density and distribution; soil compaction and erosion; alteration of stream flows and ground water levels; drainage; lowering of water, air, and noise levels and unauthorized acts including use and release of toxic chemicals, introduction of exotic species, and removal of native species. Though relationships are less clear, at some point increased visitor use and/or physical and biological impacts will result in sociological impacts.

Measures designed to mitigate the above listed impacts include: prescribed and natural fire management, threatened and endangered plant and animal management, exotic plant control, air quality management, wilderness impact monitoring, air management, deer herd and range monitoring, vector control and plant propagation and revegetation. To a lesser degree all other natural resource management programs are attempts to mitigate past or present use or development in or near the Park. It follows that preservation of natural resources can best be accomplished with a minimum of development and use. And without controls on each, preservation of natural resources will be impossible.

Research is an extremely important component of this plan. The overall objective of the research program is the accumulation and synthesis of scientific information concerning the ecosystems of the Park that will permit effective management and interpretation and description of Park ecosystems, the evaluation of visitation on the natural resource base, and the ecological evaluation of managment programs.

Basic to the management of any natural area is information concerning the ecosystems and their component parts. Much data already exists although no systematic analyses have been made. Needed are inventories of resources, analyses of processes, and classification of ecosystems.

Fundamental inventory information is available for some resources, although it is either out-of-date, or on maps of a variety of scales. Existing inventories must be updated and coded on maps in such a way that it is readily retrievable. Additional studies will have to be initiated to gather inventory information not presently available. Basic inventories will include vegetation, soil, water, geology, climate, physiography and fauna.

Once basic inventory information is complete, the ecological processes, which perpetuate the various Park ecosystems, will be investigated. Specific examples include the relationship between vegetation and environmental gradients such as elevation and moisture, the role of fire as a dynamic ecological factor, and interrelationships between the various mammalian species populations.

A result of the research in the above two categories would be a classification and description of Park ecosystems. Classification schemes could be based on dynamic properties, static characteristics or steady states. A classification allows the extrapolation of specific data to extensive area.

Since parks do not exist in an ecological vacuum, any analyses would be incomplete without considering the impact of human beings. An evaluation of the sociological and ecological characteristics of the visitor-resource system is essential for assessing the impact of human activities.

Various social parameters control behavior in natural environments. Information concerning such parameters, their implementation, and dissemination, would aid development and protection of Park resources.

The development of use levels must consider both psychological and ecological factors. Knowledge concerning the interaction between an individual and the environment forms the basis for such determinations. Research in this field will lead to use levels for the backcountry as well as for the developed areas.

Research efforts will be directed to the ecological evaluation of management programs and toward the development of improved natural resources management techniques and methods.

As management programs are conducted, it is important the the responses to management actions be monitored. Specific examples include research concerning effectiveness of vegetative restoration, wildlife management, and fire management programs.

Often, unique conditions warrant the development of specific management techniques where gaps in expertise exist because of a lack of knowledge. Research efforts have refined techniques for the managed use of fire and will now be directed towards its interface with air quality management. Other areas in need of additional technical information are control of exotic plants, backcountry use impacts, deer herd and range dynamics and threatened and endangered species.

NATURAL RESOURCES PROJECT STATEMENT

1. YOSE-N1-ENVIRONMENTAL RESTORATION BY PRESCRIBED BURNING:

2. STATEMENT OF PROBLEM:

All major plant communities of the Sierra Nevada evolved with natural, lightning-caused fires. Many plants in these communities have developed adaptations to frequent fires, and have become dependent upon such fires for their reproduction and perpetuation. This is especially true for the mixed-conifer species, giant sequoia, California black oak, chaparral species, and low and mid-elevational meadow communities.

Many plant communities in Yosemite have been adversely affected by the suppression of naturally occurring fires. Trends in plant community succession have been altered, resulting in unnatural shifts in species composition. The forest canopy is becoming increasingly closed, excluding grasses, forbs, and shrubs which formerly occurred in forest openings. These changes are particularly noticeable in the chaparral oak woodland, lower mixed-conifer, and upper mixed-conifer community which generally occur below 7500 feet (2300 meters) in the Park. Subtle, but important, hydrological changes may have taken place as a result of dramatically increased plant biomass. This may be an especially important factor in the existence of the low elevation meadows. The absence of fire has accelerated the invasion of these meadows by coniferous trees. The natural mosaic of diverse vegetative types is slowly being replaced by dense stands of fire-intolerant plants, especially at lower elevations. All of these changes have, in turn, caused a deterioration in the habitat favored by many forms of wildlife.

The forest has become increasingly susceptible to catastrophic wildfire as both living and dead fuel loads continue to increase. The increasing density of trees has created a hazardous arrangement of unnatural fuel ladders on which fire can ascend to the overstory, and it has also increased the number of trees susceptible to insect attack and disease.

The absence of the open, park-like forest described by early explorers in the Yosemite region has resulted in visual impairment of the natural scene and, consequently, has decreased the value of the Park experience for many visitors. This is especially true in the upper and lower mixed-conifer forest, including Yosemite Valley, where vegetative change has been most pronounced.

Current National Park Service policy recognizes that fire is a natural process necessary for the perpetuation of certain plant and animal communities. It also directs that fires resulting from natural causes should be considered natural phenomena and allowed to burn without interference from man as long as they achieve management objectives and remain within predetermined boundaries. Most mixed-conifer and chaparral vegetative types must be prescribed burned to reduce the unnaturally heavy live and dead fuel loads before they can be included in natural fire management zones. Also, without prescribed burning there is a greater chance that lightning fires burning in the natural fire zones may escape into the mixed-conifer areas and require suppression. Park Service policy allows prescribed burning to be used to simulate the effects of natural fire in ecosystems which have been substantially altered from the natural state through fire exclusion and in sites where heavy visitor use and developments warrant maximum control of fire.

The current prescribed burning program was initiated in 1970, and since that time 55 units have been burned for a total of 15,914 acres (6243 hectares). Initial efforts were concentrated in high value areas in great need of vegetative restoration, such as Yosemite Valley and the sequoia groves. Other areas in the mixed-conifer forest were burned as burning techniques and prescriptions were refined. Until 1970, most of the prescribed burning was carried out in the spring and unit areas were kept small, averaging only 138 acres (56 hectares). Since 1978, emphasis has been placed on fall prescribed burning of substantially larger and more ecologically significant areas. From 1970 to 1980, there were 15 prescribed burns for 10,107 acres (4092 hectares).

In 1979, a comprehensive Natural, Conditional, and Prescribed Fire Management Plan was approved. This plan established 71 prescribed burning units which are to be burned on a rotational schedule of eight or nine years. This rotation along with the emphasis on utilizing fall backing fires ignited on ridges will simulate to the extent possible the natural fire regime in the mixed-conifer forest. This plan was revised in 1981 to designate 70 prescribed burning units containing 58,854 acres (23,827 hectares). The designated units now comprise 34 percent of the 169,544 acres (68,641 hectares) in the Suppression and Conditional Fire Management Units. The remaining 66 percent of this area needs vegetative restoration through the reintroduction of fire and may need to be designated into prescribed burning units at some future time. In addition, there are 25,387 acres (10,278 hectares) of chaparral, mostly adjacent to the Park boundary, which will need to be prescribed burned in the future but which have not yet been designated into units. The environmental impacts of this plan are assessed by the Yosemite Natural Resources Management Plan and Environmental Assesment, approved May 1977.

3. <u>ALTERNATIVE ACTIONS AND THEIR PROBABLE IMPACTS:</u>

A. <u>No Action</u>: Under this alternative there would be no prescribed burning in the Park, and fire would be totally excluded from those areas outside the natural fire management units. There would be no beneficial impacts from this alternative, either economic or ecological. Unnatural successional trends would continue causing a further shift in species composition toward climax fire intolerant species. The continued buildup of live and dead fuel loads and fuel ladders would greatly increase the chance of an uncontrollable holocaustic wildfire. Such a fire would reverse the unnatural successional trends in some areas, but at the cost of destroying the entire vegetative cover. The conversion of low elevation meadows into forests through fire exclusion would probably be irreversible. Reproduction of fire dependent plants such as giant sequoia would virtually cease. This alternative would probably result in an increase in forest pathogens and insect attacks as tree densities increased. This, in turn, would lead to increased workloads for hazard tree removal around developments. The lack of prescribed burning in the mixedconifer forest would also increase the chance of a natural fire escaping into such areas and requiring suppression. There would be a general increase in fire suppression efforts and a net increase in fire management costs without prescribed burning. At present prescribed burning costs on a per acre basis are about 1 percent of fire suppression costs. There would also be significant changes in wildlife habitat, especially for deer, since the mosaic of plant communities and the diversity of habitat would decline. Many of the plants favored by bear, deer, and other animals are favored by the seral stages of succession produced by natural and prescribed fire regimes.

The temporary decrease in smoke production resulting from fire suppression and the termination of prescribed burning would eventually be offset by tremendous volume of smoke generated by the inevitable, catastrophic wildfires resulting from this policy. Thus, there would be a net loss in air quality without the controlled release of relatively small amounts of particulates which prescribed burning provides; there would be a greater chance of violation of national ambient air quality standards by the sudden release of tremendous volumes of particulates from living and dead fuel in catastrophic wildfire. In the chaparral and mixed-conifer vegetation types, prescribed burning is the only management technique with proven ability to prevent catastrophic crown fires.

B. Continue to Carry Out Approved Prescribed Fire Management Plan: The Natural, Conditional, and Prescribed Fire Management Plan approved in 1979, establishes the following program for prescribed burning:

(1) Prescribed Fire Management: Many areas in the chaparral, lower mixed-conifer, and upper mixed-conifer communities cannot be safely included in the natural or conditional fire units at this time due to the severe fire danger produced by unnatural fuel and vegetation characteristics. Consequently, prescribed fire will be used to simulate the natural fire process and to reestablish, to the entent possible, what are judged to be pristine or natural conditions. No attempt can be made at this time to define specifically what the "natural" or "pristine" fuel-loading and vegetative composition or density might have been. It is generally known, however, that prehistoric fires in these areas were frequent and generally of low intensity.

In this forest, fire adapted species were favored; and fuel loadings were greatly reduced from present levels. Prehistoric natural fires most frequently originated on the upper slopes of ridges in the upper mixed-conifer and red fir and backed downhill into more flammable fuel concentration and types. A goal of prescribed fire management is to simulate, to the extent feasible, the burning pattern and periodicity of these fires. This is especially true for the large prescribed burning units which are remote from developments. Prescribed fire management will be the precursor to natural fire management in that once the "natural" fuel and vegetative condition is sufficiently reestablished in a burn unit, that unit will be placed under natural fire management. The natural fire process will then become a dynamic force in determining the nature of whatever vegetative pattern that may develop, Management will refrain from being prejudiced toward any specific result.

In and around developed areas, such as Yosemite Valley, and in some areas adjacent to the Park boundary, prescribed fire may become a permanent feature of vegetation and fire management. The proximity of structures, large number of people, or lands managed by other agencies with other objectives, may result in situations incompatible with natural fire management. Areas in or near Yosemite Valley or other developed areas may also be permanently excluded from natural fire management due to the necessity of closely regulating smoke density and visibility. In Yosemite Valley, the primary short-term goal will be to reproduce the vegetative pattern maintained by frequent Indian burning. The role of natural fire must be considered within the context of important man-caused determinants of vegetative change, such as the lowering of the water table by removing the Bridalveil terminal moraine, in any long-term management plan.

Under this program, management fires will be ignited in designated burn units within specified weather, fuel moisture, and fire behavior paramenters (Table 2). The seventy burn units which have been established will be burned on a fixed rotational schedule to the extent possible. The 29 Yosemite Valley units and the 16 Sequoia Grove units will be burned on a 8 year rotation and the 25 Parkwide units will be burned on a 9 year rotation. Although the precise periodicity of prehistoric, naturally occurring fires in Yosemite is unknown, the 8 to 9 year rotation is compatible with most fire periodicity studies involving the Sierra mixed-conifer forest and with Park fire history records. These 70 burn units, which comprise 23,827 hectares (58,854 acres), are all located in routine fire suppression zones or overlap with conditional fire units. In order to achieve the necessary rotation, an average of 2648 hectares (6,539 acres) must be burned each year. Park-wide units must of necessity be large in order to achieve this goal. Boundaries for these units include defensible barriers, such as roads, trails, major creeks, or cliffs.

Some units have open boundaries into the less flammable vegetation types included in natural fire management. In some instances, however, control lines must be constructed prior to burning. Yosemite Valley and Sequoia Grove units are located in areas of development and high visitor use. Therefore, their size is kept small to facilitate the control of smoke emissions and of unforseen problems which might develop.

Other areas in the lower and upper mixed-conifer will be included within existing prescribed burning units or will be designated as additional units when it becomes feasible to do so. It is expected that natural fires in the conditional units will progressively reduce the area which will eventually need to be prescribed burned. Units may also be withdrawn from conditional or prescribed burning management and placed under natural fire management.

Prescribed burning will be carried out primarily during the months of March, April, September, and October. Only 10 percent of the acreage designated for prescribed burning will be burned in the spring. Spring burning will be limited to small, forested areas and meadows in Yosemite Valley and to five of the smaller, low elevation Park-wide units. These Park-wide units are all south or west facing and contain dense stands of understory trees which can be effectively thinned by spring headfires. Yosemite Valley meadows will be burned in early spring when adjacent forests are too wet to burn and, thus, act as fuel breaks. Although spring burning is an effective vegetation management tool, its use is limited to lessen the effects of burning during a period of infrequent natural fire occurrence and to lessen the risk of fires burning into the summer months under conditions which will be out of prescription.

The prescribed burning program will emphasize the use of fall backing fires. These fires are preferred since they closely simulate natural fire behavior and occur during the more "natural" season than do spring prescribed burns. The use of fall backing fires will also minimize fires, and dry fall fuels produce less visible smoke than do wet spring fuels. Fall burning also generally progresses into less severe burning conditions. Consequently, there is less danger that the prescription will eventually be lost than with spring burns of long duration.

Priorities for burning are determined by the length of time since previous burning, current fuel-loading and vegetative conditions, topographic advantage, and by manpower and logistical requirements. When feasible, upper elevational units are scheduled first, either because they share a common boundary with the natural fire units or because they can provide a barrier against possible escape fires from lower burn units, especially those scheduled for spring burning.

The following schedule (Table 1) will be followed for presently designated units from 1982 through 1987. For a list of designated units prescribed burned from 1970 through 1981, refer to the 1979 Yosemite Natural, Conditional, and Prescribed Fire Management Plan. Yosemite Valley units are preceded by YV; Mariposa Grove units are preceded by MG; Merced-Tolumne Grove units are preceded by MTG; and Park-wide units are preceded by PW.

Table 1. PRESCRIBED BURNING UNIT SCHEDULE FROM 1982 to 1987.

Year	Season	Unit No.	Hectares	(Acres)
1982	Fall	YV16	25	(62)
1982	Fall	YV20	10	(25)
1982	Fall	YV27	18	(44)
1982	Fall	MG2	20	(49)
1982	Fall	MTG2	6	(15)
1982	Fall	PW3	1943	(4799)
1982	Fall	PW7	789	(1949)
1982	Fall	PW8	769	(1899)
1982	Fall	PW16	727	(1796)
TOTAL 1982			4307	(10639)
1983	Spring	YV17	25	(94)
1983	Spring	YV28	15	(37)
Spring Total 1983			53	(131)
1983	Fall	MG3	16	(40)
1983	Fall	MTG8	3	(7)
1983	Fall	PW1	1235	(3050)
1983	Fall	PW2	729	(1801)
1983	Fall	PW14	1113	(2749)
Fall Total 1983			3096	(7647)
TOTAL 1983			3149	(7778)
1984	Spring	YV2	12	(30)
1984	Spring	YV9	46	(114)
1984	Spring	YV12	16	(40)
1984	Spring	YV18	38	(94)
1984	Spring	YV19	24	(59)
1984	Spring	YV21	26	(64)
1984	Spring	YV22	26	(64)
1984	Spring	YV23	10	(25)
1984	Spring	YV24	5	(12)
1984	Spring	PW13	186	(459)
Spring Total 1984			389	(961)

1984	Fall	MG1	12	(30)
1984	Fall	MTG5	4	(10)
1984	Fall	PW19	2874	(7100)
Fall Total 1984			2890	(7138)
TOTAL 1984			3279	(8099)
1985	Fall	YV25	18	(44)
1985	Fall	YV29	37	(91)
1985	Fall	MG8	32	(79)
1985	Fall	MTG3	4	(10)
1985	Fall	PW20	1741	(4300)
1985	Fall	PW5	146	(361)
1985	Fall	PW15	567	(1400)
TOTAL 1985			2545	(6286)
1986	Spring	YV7	12	(30)
1986	Spring	YV10	38	(94)
1986	Spring	YV27	12	(30)
1986	Spring	PW21	607	(1499)
Spring Total 1986			669	(1652)
1986	Fall	MG6	32	(79)
1986	Fall	MTG4	6	(15)
1986	Fall	PW18	1134	(2801)
Fall Total 1986			1172	(2895)
TOTAL 1986			1841	(4547)
1987	Spring	YV13	32	(79)
1987	Spring	YV14	9	(22)
1987	Spring	YV15	17	(42)
1987	Spring	PW22	243	(600)
Spring Total 1987			301	(743)
1987	Fall	MG7	28	(69)
1987	Fall	MGT1	7	(17)
1987	Fall	PW12	1296	(3201)
Fall Total 1987			1493	(3688)
TOTAL 1987			1794	(4431)

Small areas of bear clover, meadows, and chaparral within units may be burned adventitiously during the late fall and winter months when surrounding areas within the unit are too wet to burn. This will provide the flexibility necessary to take advantage of unseasonably dry periods in the winter when these extremely flammable fuel types may be burned safely with head fires.

(2) Smoke Management: All prescribed and natural fires will comply with the air pollution control permit and burn-day requirements specified by the California Air Resources Board and the affected County Air Pollution Control Districts. Presently, natural and prescribed fires above 1,830 meters (6000 feet) are exempt from the permit and burn-day requirements under state and county regulations.

(3) Prescriptions: A prescription is a set of site specific environmental conditions and fire behavior indices which is dependent on fuel model and firing technique, and which can be used to delineate a range of acceptable fire behaviors and effects. The prescriptions for burning in Yosemite (Table 3) are tentatively approved by the Park Research Scientist and the Resources Management Division. The prescription parameters are all retrievable through a custom display of the Administrative and Forest Fire Information Retrieval and Management Systems (AFFIRMS) based on the 1978 NFDRS. These prescriptions may be refined further as deemed necessary by the Research Scientist and the Resources Management Specialist. The Research Scientist may, with approval from the Superintendent, ignite fires on research plots for this purpose.

Table 2. 1981 PRESCRIBED BURNING PRESCRIPTIONS, YOSEMITE NATIONAL PARK, BASED ON NFDRS AND NFFL FIRE BEHAVIOR SYSTEM.

HEAD FIRES

FUEL MODEL	F (6)	G (10)	L (1)	U (9)	U (9)
VEGETATION	Manzanita Ceanothus Huckleberry Oak	Incense Cedar White Fir Sugar Pine	Perennial Grasses	Ponderosa Pine	Ponderosa Pine/Bear Clover
Air Temperature	30-75	30-75	30-75	30-75	30-75
Relative Humidity	30-65	30-65	30-65	30-65	30-65
Wind Speed (mph)					
Mid-Flame	0-6	0-3	0-6	0-6	0-6
20 Foot	0-13 (3)	0-13 (4)	0-13 (3)	0-25 (4)	0-25 (4)
1-Hour TL	5-6	6-8	6-8	6-8	7-10
10-Hour TL	9-13	9-13		9-15	9-16
100-Hour TL	10-18	10-20		10-20	10-20
1000-Hour TL		15-30		15-30 (1)(2)	15-30 (1)(2
Spread Component	3-16	3-12	1-109	1-9	1-8
Rate of Spread (ch/hr)	10-50	3-7	4-135	2-7	2-6
Energy Release C.	10-17	15-33	1-4	12-20	10-15
Heat/Unit Area (BTU/ft^2)	400-500	1200-1400	84-91	340-400	300-400
Burning Index	15-40	20-49	2-51	9-32	9-28
Flame Length (ft)	3.4-7.0	3-5	1-5	1.4-2.6	1.3-2.5
Fireline Intensity (BTU/ft/s)	80-450	60-170	6-224	11-45	10-40

BACKING FIRES

FUEL MODEL	F (6)	G (10)	G (10)	H (8)	U (9)	U (9)
VEGETATION	Manzanita Ceanothus Huckleberry Oak	Incense Cedar White Fir Sugar Pine	Giant Sequoia	White Fir Red Fir	Ponderosa Pine	Ponderosa Pine/Bear Clover
Air Temperature	40-90	40-85	50-90	40-90	40-85	40-85
Relative Humidity	20-40	20-50	20-50	20-40	20-50	25-60
Wind Speed (mph)						
Mid-Flame	0-6	0-6	0-6	0-6	0-6	0-6
20 Foot	0-13 (3)	0-25 (4)	0-25 (4)	0-25 (4)	0-25 (4)	0-25 (4)
(enter zero wind, zero slope)						
1-Hour TL	4-6	4-8	3-6	3-8	4-8	4-8
10-Hour TL	6-10	6-10	6-8	5-10	6-10	6-10
100-Hour TL	7-12	7-15	7-12	7-12	8-15	8-15
1000-Hour TL		10-20	10-15	10-20 (2)	10-20 (1,2)	10-20 (1,2
Spread Component	1-4	2-3	2-3	0-1	1-2	1-2
Rate of Spread (ch/hr)	2-7	1-2	1-2	0-1	1-1	1-1
Energy Release C.	15-30	35-60	40-60	20-40	25-39	25-39
Heat/Unit Area (BTU/ft^2)	400-500	1200-1400	1000-1500	180-250	350-450	350-450
Burning Index	12-27	20-32	22-32	11-18	14-22	14-22
Flame Length (ft)	1.5-3.2	1.6-2.4	1.7-2.4	.4-.5	1-1.2	1-1.2
Fireline Intensity (BTU/ft/s)	15-70	16-35	18-36	.8-1.3	5-8	5-8

(1) The NFDRS fuel model contains no fuels in this size class; thus recorded values do not affect Spread Component, Energy Release Component and Burning Index. The 1000 hr. TL may be important to assess where such fuels actually exist in the vegetation type and where the moisture content in deep duff layers needs to be assessed.

(2) The NFFL fuel model contains no fuels in this size class; thus recorded values do not affect calculated Rate of Spread, Heat/Unit Area, Flame Length, and Intensity. The 1000 hr. TL may be important to assess where such fuels actually exist in the vegetation type and where the moisture content in deep duff layers needs to be assessed.

(3) Mid-flame windspeed conversion based on exposed fuels.

(4) Mid-flame windspeed conversion based on partially sheltered fuels.

BACKING FIRES

MODEL	F (6)	G (10)	G (10)	H (8)	U (9)	U (9)
TATION	Manzanita Ceanothus Huckleberry Oak	Incense Cedar White Fir Sugar Pine	Giant Sequoia	White Fir Red Fir	Ponderosa Pine	Ponderosa Pine/Bear Clover
Temperature	40-90	40-85	50-90	40-90	40-85	40-85
:ive Humidity	20-40	20-50	20-50	20-40	20-50	25-60
Speed (mph)						
Mid-Flame	0-6	0-6	0-6	0-6	0-6	0-6
20 Foot	0-13 (3)	0-25 (4)	0-25 (4)	0-25 (4)	0-25 (4)	0-25 (4
:r zero wind, :ero slope)						
:r TL	4-6	4-8	3-6	3-8	4-8	4-8
:ur TL	6-10	6-10	6-8	5-10	6-10	6-10
:our TL	7-12	7-15	7-12	7-12 (2)	8-15 (1,2)	8-15 (1
Hour TL		10-20	10-15	10-20	10-20	10-20
d Component	1-4	2-3	2-3	0-1	1-2	1-2
:of Spread (ch/hr)	2-7	1-2	1-2	0-1	1-1	1-1
:y Release C.	15-30	35-60	40-60	20-40	25-39	25-39
Unit Area (BTU/ft^2)	400-500	1200-1400	1000-1500	180-250	350-450	350-450
:ng Index	12-27	20-32	22-32	11-18	14-22	14-22
Length (ft)	1.5-3.2	1.6-2.4	1.7-2.4	.4-.5	1-1.2	1-1.2
:ine Intensity (BTU/ft/s)	15-70	16-35	18-36	.8-1.3	5-8	5-8

(1) The NFDRS fuel model contains no fuels in this size class; thus recorded values do not affect Spread Component, Energy Release Component and Burning Index. The 1000 hr. TL may be important to assess where such fuels actually exist in the vegetation type and where the moisture content in deep duff layers needs to be assessed.

(2) The NFFL fuel model contains no fuels in this size class; thus recorded values do not affect calculated Rate of Spread, Heat/ Unit Area, Flame Length, and Intensity. The 1000 hr. TL may be important to assess where such fuels actually exist in the vegetation type and where the moisture content in deep duff layers needs to be assessed.

(3) Mid-flame windspeed conversion based on exposed fuels.

(4) Mid-flame windspeed conversion based on partially sheltered fuels.

(4) Responsibilities: For a detailed treatment of responsibilities under this alternative, including Administration and Planning, Qualification and Training, Prescribed Burning Operations, Public Safety, Suppression, Public Information and Education, and Interagency Coordination, refer to the 1979 Yosemite Natural, Conditional, and Prescribed Fire Management Plan, with approved 1980 and 1981 revisions.

(5) Impacts: Adverse impacts of prescribed burning are temporary, localized deterioration in air quality and visibility. Also the scorching of small trees and shrubs and trunk blackening of some larger trees is aesthetically unpleasing. Although each prescribed burn has some potential for escape, due to the prescriptions used, here the risk is minimal. Also prescribed burning could result in damage or destruction of plants proposed for Threatened or Endangered Status. However, while individual plant losses are possible, the loss of a species from this cause is extremely unlikely since each of these species has evolved with the fire influence operating. Also such damage is largely avoidable due to the fact that all known locations of such plants are mapped, and for those species not known to be fire adapted, great care will be exercised to protect them from all prescribed burns.

Beneficial impacts come from prescriptions which predict potential fuel reductions, vegetation impacts, and safe burning limits. Where fire intensities are low, effects are limited principally to the understory, but under dry conditions, the overstory will also be affected on those site where fuel loads are high and vertical distribution is continuous. In all communities, species shifts will occur with fire adapted species such as giant sequoias and ponderosa pine being favored. Seedling germination will be improved for many species including the giant sequoia. In forest communities with moderately intense fires some of the canopy will be removed, improving growth of forbs and shrubs but consuming some of the seed. Fires may act to naturally control the extent and intensities of parasitic organisms within the forest including, for example, annosus root rot (Heterobasidon annosum). In meadows, herbaceous plants are favored by the presence of fire, and diversity usually increases with the presence of more wildflowers and forbs. Among woody plants, sprouting species such as the black oak are favored over non-sprouting species. In general, fire recycles nutrients and increases both seed production and nutrient content in shrubs and forbs.

Use of prescribed fires in meadows in Yosemite Valley will both return nutrients to the soil increasing plant growth and kill small trees invading such areas. Where trees are killed by fire decreased evapotranspiration will occur, and a higher water table will result. Since meadows are a seral stage dependent on wet conditions, these factors will tend to preserve their size.

4. RECOMMENDED COURSE OF ACTION:

Alternative A was rejected as incompatable with Park Service policy and because it would allow continued and progressive unnatural changes in Park ecosystems. It would also perpetuate and accentuate the risk of catastrophic wildfire which could severely damage the floral, faunal, visual, and aesthetic Park resources.

Alternative B, implementation of the current management plan is the recommended course of action. It offers a program which will utilize a simulated natural fire regime to the maximum extent feasible while allowing the flexibility to expand the program when it becomes possible to do so. This alternative includes a monitoring program to insure the effectiveness of prescribed burning and to better define and elucidate the role of fire within Park ecosystems. No additional research is needed to make this program operational. If monitoring reveals specific research needs, these needs can be quickly communicated to the Research Scientist.

Natural fires in the conditional fire management units will contribute to the reestablishment of natural fire regimes in those areas and lessen the need for a prescribed burning program in those areas. The inclusion of certain prescribed burn units in natural or conditional fire management units once they have been burned will also utilize natural processes to the maximum extent possible and end human manipulation as soon as possible. It will also allow closer adherence to burning schedules and for the designation of new prescribed burning units to be accelerated.

Smoke generation will be greatest on the initial prescribed burning of a unit due to the accumulation of fuels for up to 100 years. Subsequent prescribed burning will produce much less smoke and consequently will produce fewer conflicts with air quality and visibility standards.

5. FUNDING:

A. Recurrent Funds Available in Park Base..............$99,700.00

B. O.N.P.S. Funds Requested...........................$53,700.00

NATURAL RESOURCES PROJECT STATEMENT

1. YOSE-N2-PRESCRIBED NATURAL FIRE MANAGEMENT

2. STATEMENT OF PROBLEM:

All major plant communities of the Sierra Nevada evolved with natural lightning caused fires. Many plants in these communities have developed adaptations to frequent fires, and have become dependent upon such fires for their reproduction and perpetuation. Lightning fires are an important ecological process in all forests, even those up to tree limit, although at the higher elevations, fire is a more subtle and infrequent element than at lower elevations.

Plant communities at all elevations have been adversely affected by the suppression of naturally occurring fires. Trends in plant community succession have been altered, resulting in unnatural shifts in species composition. The forest canopy is becoming increasingly closed, excluding grasses, forbs, and shrubs which formerly occurred in forest openings. These changes are particularly noticeable in the lower elevation vegetation types, where the processes of growth and decay are more rapid. The natural mosaic of diverse vegetation types is slowly being replaced by dense stands of fire-intolerant plants, especially at lower elevations. All of these changes have, in turn, caused a deterioration in the habitat favored by many forms of wildlife.

The forest has become increasingly susceptible to catastrophic wildfire as both living and dead fuel loads continue to increase. The increasing density of trees has created a hazardous arrangement of unnatural fuel ladders on which fire can ascent to the overstory, and it has also increased the number of trees susceptible to insect attack and disease.

The absence of the open, park-like forest described by early explorers in the Yosemite region has resulted in visual impairment of the natural scene and, consequently, has decreased the value of the Park experience for many visitors. This is especially true in the upper and lower mixed-conifer forest, including Yosemite Valley, where vegetative change has been most pronounced.

Current National Park Service policy recognizes that fire is a natural process necessary for the perpetuation of certain plant and animal communities. It also directs that fires resulting from natural causes should be considered natural phenomena and allowed to burn without interference from man as long as they achieve management objectives and remain within predetermined boundaries.

The natural fire program in Yosemite was initiated in 1972 with four units comprising 19 percent of the Park. Since prior to that time all lightning fires were suppressed, little was known about the potential extent, intensity, or longevity of such fires, or about the management problems they might present. A conservative approach was adopted. Natural fires were initially restricted to alpine and sparsely vegetated areas with only moderate fire incidence, which were contained within secure barriers to fire spread. These units were gradually expanded to include almost all areas in which the vegetative communities have experienced only minor changes as a result of fire suppression activities. This expansion was justified by knowledge of fire behavior and ecology gained by monitoring natural and prescribed wildfires.

Since 1975 natural fires have been allowed to burn in certain areas only after September 1, each year when certain prescribed fire behavior indicies have been achieved. These areas, called conditional natural fire management units, originally comprised 18 percent of the Park.

In 1979 a comprehensive Natural, Conditional, and Prescribed Fire Management Plan was approved. In 1981 this plan was revised to expand the natural fire unit, eliminate certain suppression corridors along roads, and establish a new category of conditional natural fire management units in which the prescription is based on fuel loading recovery following prescribed burning rather than on fire behavior indices. This plan designates the natural and conditional units, the procedures and responsibilities for executing and monitoring the program.

Since 1972, there have been 239 natural fires and these have burned 17,525 acres (7,095 hectares). Containment action was taken against six natural fires which threatened to burn outside the natural fire unit or to violate air quality standards. No natural fire has actually escaped from the natural fire unit.

Table 1 summarizes the history of natural fire management through the fall of 1981.

Table 1. Natural and Conditional Fire Management

Year	Acres in Units	Percent of Park	No. of Fires	Total Acres Burned
1972	187,007 (75,711 ha.)	19	8	.31 (.13 ha.)
1973	464,405 (188,018 ha.)	61	27	56.09 (22.70 ha.)
1974	464,405 (188,018 ha.)	61	22	3711.71 (1502.71 ha.)
1975	614,238 (248,679 ha.)	81	20	773.87 (313.31 ha.)
1976	614,238 (248,679 ha.)	81	35	803.83 (325.32 ha.)
1977	614,238 (248,679 ha.)	81	24	149.76 (60.63 ha.)
1978	640,008 (259,111 ha.)	84	33	2485.65 (1006.34 ha.)
1979	640,008 (259,111 ha.)	84	6	78.24 (31.68 ha.)
1980	640,008 (259,111 ha.)	84	25	6203.39 (2511.49 ha.)
1981	656,104 (265,629 ha.)	86	39	3262.39 (1320.81 ha.)
		TOTAL	239	17525.24 (7095.24 ha.)

3. ALTERNATIVE ACTIONS AND THEIR PROBABLE IMPACTS:

A. No Action: This alternative would result in continued deterioration of the natural environment since the Park would revert to a full fire suppression policy. The benefits of this alternative would be less visitor inconvenience resulting from reduced smoke levels in the backcountry and less chance that backcountry trails would be closed due to dangerous fire situations. The primary adverse impact would be: the steady increase in live and dead fuel loadings which would increase the likelihood of a catastrophic wildfire which would destroy the vegetative cover and associated wildlife and scenic resources over a large area of the Park. In the absence of fire a climax vegetation generally excluding the fire dependent and fire tolerant species would evolve. This climax would offer far less diversity in species composition and wildlife habitat than the seral successional stages sustained by fire.

This alternative would violate Park Service policy which directs that the natural role of fire in areas such as Yosemite should be reestablished as much as possible.

B. Continue Current Approved Natural Fire Management Program:

(1) Natural Fire Management: Under this alternative, all naturally occurring fires within the natural fire management units will be allowed to burn at any time of the year and under any weather conditions unless they threaten human life, cultural or archaeological resources, physical facilities, endangered or threatened species, to escape from management units, to violate air pollution control laws and regulations, or to violate other resources management objectives. All natural fires will be monitored frequently in order that managers will maintain current information on fire size, rate of spread, intensity, location, and potential threats which might require suppression action. No fires will be ignited by management in the natural fire units, with the following exceptions: (a) certain fires may be ignited in conjunction with suppression efforts as subsequently outlined; (b) if it is determined that any threatened or endangered species is critically fire dependent and that fire exclusion has so adversely affected the critical habitat of any species as to endanger its existence, then active steps may be taken to restore that habitat through prescribed burning; (c) prescribed fires may be allowed to burn from lower elevation management units into the natural fire management units. This will occur only on large fall burns on which it would be impractical and environmentally unwise to construct extensive firelines to separate the prescribed burning unit from the natural fire unit. The less flammable vegetation types and milder burning conditions in the natural fire units will serve to delimit fires which are burning in prescription in the prescribed burning units.

Present units are designed to include those areas in which unnatural vegetative changes resulting from fire suppression activities have been minor. This will insure that natural fire behavior and effects will resemble that which would have occurred under pristine conditions. Slightly more than half of the upper mixed-conifer and almost all of the red fir and higher elevation communities are presently included. Portions of the lower mixedconifer and chaparral are included, especially in the Rancheria Mountain area. This area was burned by a large fire in 1948, and the resulting vegetative conditions, combined with good natural and man-made barriers, permit its inclusion at this time.

The boundaries for the natural and conditional fire units were selected to incorporate the appropriate vegetation communities and to provide a secure barrier to fire spread. Another important criteria was that the boundaries be easily identifiable from the ground or air. Compromises were necessary in integrating these goals. The boundaries which were finally chosen follow natural or man-made barriers, such as major stream courses, open granite ridges, lakes, roads, and trails.

(2) Conditional Fire Management: Conditional fire management involves an extension of natural fire management into lower elevational zones and vegetative communities when certain prescribed conditions are achieved. There are two categories of conditional fire management, depending on the type of prescription.

Category I: Park-wide prescribed burning units 6, 9, and 27 (Lake Eleanor) are included under full-year conditional fire management until such time as dead and downed fuels less than 1 inch in diameter recover to 50 percent of the loadings that existed prior to prescribed burning. Other prescribed burning units may be added to this catagory in the future. Permanent fuel loading transects will be monitored annually to ascertain when the 50 percent level has been achieved. At that time the affected unit will revert to full fire suppression and will be prescribed burned again on the rotational schedule.

Catagory II: All other conditional fire management units will be activated only during the fall and winter months when certain prescribed fire behavior conditions have been achieved. These units encompass portions of the lower and upper mixed-conifer and red fir cover types in which fuel loadings and summer fire danger are currently high enough to preclude all-year natural fire management. Under this program, naturally occurring fires within the conditional fire management units are allowed to burn once the running seven-day mean of the Burning Index, as measured at Crane Flat, using NFDRS fuel model G, reaches 50 on or after September 1. This prescription has been found to mark the inception of a seasonal downward trend in fire behavior in Yosemite. It is based on an analysis of historical fire weather recorded under the National Fire Danger Rating System as well as conditional management fires.

Catagory II conditional fire management will be routinely terminated on February 28 each year so that there will be no carryover fires burning into spring and the coming fire season. After this terminating date new natural ignitions will be suppressed but existing fires will be allowed to continue burning. Management also has the option of igniting fires in conditional units to achieve management objectives. The prescriptions for this burning will be the same as those designated for any other prescribed burning in Yosemite National Park.

(3) Man-Caused Fires: Within the natural and conditional units, man-caused fires will be routinely suppressed except where such fires pose no risk to the resource or public safety and where the environmental impact of suppression would not be commensurate with the adverse effects of the fire. Examples of this situation would be man-caused fires burning through a subalpine meadow or through a treeline stand of whitebark pine. In such situations, the adverse environmental impact from suppression, such as firelines or tree felling, might be greater than the effects of the man-caused fire. In such situations the Superintendent will decide the course of action based upon the recommendations of the Chief of Resources Management and the Fire Management Officer. The cause of all fires within the natural and conditional units will be determined in order that the proper management decision will be made.

(4) Loose-Herding of Natural Fire: Naturally occurring fires in suppression areas may be loose-herded and allowed to burn out with only partial suppression or limited containment if such fires have a high potential for environmental restoration. This procedure will be especially useful in situations where fires in proposed wilderness areas are burning toward natural or conditional units. Under this provision management will have the flexibility to analyze each individual wildfire and select the suppression strategy best suited to the environmental setting and conditions. Such fires can only be employed when environmental conditions are within the limits set for prescribed burning and when there are no threats to public safety and property.

(5) Smoke Management: All natural fires will comply with the air pollution control permit and burn-day requirements specified by the California Air Resources Board and the

affected County Air Pollution Control Districts. Presently, natural fires above 1,830 meters (6,000 feet) are exempt from the permit and burn-day requirements under state and county regulations.

(6) Responsibilities: For a detailed treatment of responsibilities under this alternative, including Administration and Planning, Qualification and Training, Public Safety, Suppression, Public Information and Education, and Interagency Coordination, refer to the 1979 Yosemite Natural, Conditional, and Prescribed Fire Management Plan, with approved 1980 and 1981 revisions.

Adverse impacts are some periodic deterioration of air quality and visibility due to smoke emissions; some inconvenience and risk to backcountry users from trail closures or fires; minor threats to cultural resources and the aesthetic impact of burned vegetation.

Beneficial impacts are the restoration of an extremely important natural process. Specific benefits are the creation and perpetuation of a natural vegetative mosaic and generally improved wildlife habitat.

This alternative will restore the natural fire process throughout a significant portion of park ecosystems, and provides for the eventual expansion of natural fire management as it becomes feasible. Natural fire incidence and size will continue to vary dramatically from year to year. Historical averages indicate that about 75 percent of natural ignitions have occurred in areas that are presently designated as natural or conditional fire management units. Thus, the Park can expect an average of about 33 natural fires and about 3,000 acres (1,215 ha.) burned each year. This will reestablish seral successional stages in many areas and create a mosaic of vegetative types and forest age classes. Experience with this program has already demonstrated that natural fires will burn against the perimeter of past burns and go out or experience a dramatic decrease in rate of spread and intensity; thus the program serves to limit the size of new natural fires as they occur.

There has been a marked increase in herbaceous plants and shrubs following most moderate or highly intense natural fires, and this has increased vegetative diversity and improved wildlife habitat. Future fires will continue this trend.

Smoke from large natural fires has produced a noticeable deterioration in air quality and visibility on two occasions. Each incident coincided with the occurrence of a prolonged and severe atmospheric inversion over the Park. Such situations can be expected to reoccur. If primary or secondary ambient air quality standards are violated or threatened, containment or suppression action will be initiated. The Park maintains one permanent and one temporary air quality monitoring station in Yosemite Valley.

In 1980, the Park Service closed several miles of trail in the backcountry due to the hazards presented by natural fires. Trail closures, sometimes for months at a time, will probably occur in the future. This, in turn will cause a redistribution or reduction in backcountry use and human impact.

4. RECOMMENDED COURSE OF ACTION:

Alternative B is recommended since it offers the best balance of benefits and risks and complies with Park Service policy. Alternative A would fail to comply with Park Service policy since it would provide no mechanism for reestablishing the natural role of fire.

Alternative B would continue to correct all of the problems resulting from fire exclusion and provides the flexibility to utilize knowledge which will become available through monitoring. Permanent transects for monitoring changes in fuel and vegetation produced by natural fires have been established on several burns. On-site monitoring during natural fires permits an analysis of the relationship between fire behavior and effects. This information can then be used to better understand the role of fire in various vegetative types and to make refinements in the management program. Research projects may be initiated in the future if monitoring reveals a lack of knowledge in specific areas which are critical in management decision-making. Research is currently underway to refine dead and downed fuel models for increased accuracy in fire behavior predicting. This and future research will be carried out by the Research Scientist or will be contracted for by him as he deems necessary.

5. FUNDING:

A. Recurrent Funds Available in Park Base..............$22,200.00

B. O.N.P.S. Funds Requested...........................$13,900.00

1. YOSE-N3-WILDLAND FIRE SUPPRESSION

2. STATEMENT OF PROBLEM:

The gross area of Yosemite National Park and the El Portal Administrative Site is approximately 762,325 acres. Of this total, 591,776 acres are included in Natural Fire Management Units and rarely require any fire suppression. The remaining 170,549 acres encompass the heavily forested one-third of the Park and range in elevation from 1,800 to 7,000 feet. Within the lower portions of this belt, fuel accumulations and plant succession resulting from 100 years of fire suppression; along with topographic, meteorological, and visitor use patterns, combine to make for a serious wildland fire problem. Virtually all developed areas lie within this belt, with property value and peak daily visitor use exceeding $130,000,000.00 and 25,000 people respectively. Over 200,000 acres of mature coniferous forests, including three irreplaceable sequoia groves, are involved. Each year, as fuel loads increase, the problem becomes more critical.

The upper portions of the above belt include 64,328 acres managed as Conditional Fire Management Units. Fires are suppressed within these units shortly before and through the fire season. However, since the risk of holocaustic fire is low, natural occurring fires are allowed to burn on or after September 1 whenever certain prescribed conditions are met.

Although Prescribed and Natural Fire Management programs have resulted in some fuel reductions, fuel loads are still increasing in untreated areas and risk to visitors property and resources from wildland fire continues to be great. Structural fire suppression, though nominally a separate function, complicates the problem, since such fires can become wildland fires. Since 1971, six major structural fires and a great number of lesser fires have endangered the wildland resource.

By 1910, an effective fire suppression program was in effect here. The current Fire Management organization is highly organized and professionally staffed. The organization is headed up by a Fire Management Officer. Other permanent personnel consist of a Park Ranger and six Supervisory Park Technicians. Additional personnel, about 30, are temporary Park Aids and Technicians usually employed between May 1 and September 30. These personnel are organized into four-person, fire suppression modules to best support helicopter operations. Based upon fire frequency, these modules are stationed at Wawona, El Portal, Yosemite Valley, Crane Flat Lookout and Lake Eleanor.

Since 1972, the Fire Management organization has permitted only one wildland fire to achieve a size of 555 acres.

Through the Fire Management organization, the Park maintains effective cooperative relations with Boise Interagency Fire Center, U.S. Forest Service, California Department of Forestry and local fire organizations.

3. ALTERNATIVES AND THEIR PROBABLE IMPACTS:

A. No Action: Continue current program which requires the suppression of wildfires, and continue presuppression program to hold fire starts to the lowest possible level except for the following:

(1) natural fires are allowed to run their course or are loose-herded consistent with procedures for Natural and Conditional Fire Management.

(2) prescribed burning is carried out in accordance with procedures for Environmental Restoration by Prescribed Burning.

(3) suppression of natural fires meeting the plan criteria for control.

For those fires routinely suppressed, impacts would be proportional to the degree of natural fire occurrence. Adverse impacts of fire suppression in forests include a denser canopy; dense, stagnant thickets in the understory; large accumulations of fuels on the floor; and species changes toward shade-tolerant trees with declines in shrubs and herbs. Impacts on chaparral brush fields are shifts to late successional species, heavy accumulation of dead standing fuel, decadence, and thickening of shrubs. Reproducing the original vegetative mosaic is virtually impossible without the presence of fire. Habitat for many animal species, mule deer and black bear in particular, deteriorates with the long-term absence of fire due to changes in forage species.

Beneficial impacts would occur in areas which are already densely covered and contain unnaturally large fuel accumulations and fuel ladders. Here, fire suppression is necessary during certain periods of the year to prevent abnormal successional setback, and soil loss, deterioration of air quality and to protect people and property.

B. Suppress All Wildland Fires: All wildland fires would be suppressed and a presuppression program would hold fire starts to the lowest possible level. This alternative would eliminate all Natural and Conditional Fire Management.

Adverse impacts would be the same as those described in the No Action Alternative but the scope of these impacts would be much greater.

Beneficial impacts would be as described above.

4. RECOMMENDED COURSE OF ACTION:

Alternative B is rejected in that it would reinstate a policy of action that has led to current ecological imbalances. If continued indefinately, such a course would cause further imbalances and ultimately result in significant natural resource losses.

Alternative A is the recommended course of action and if continued in concert with recommended alternatives for YOSE-N1 and N2, would provide proper protection for people, property and resources while allowing the fire process to continue vital rehabilitation of fire dependent ecosystems.

5. FUNDING:

A. Recurrent Funds Available in Park Base............$ 75,000.00

Emergency funding would be available through Normal Fire Year Programming in the form of Emergency Presuppression, Emergency Suppression and Emergency Fire Operations.

B. O.N.P.S. Funds Requested..........................$166,500.00

NATURAL RESOURCES PROJECT STATEMENT

1. YOSE-N4-GIANT SEQUOIA GROVE RESTORATION

2. STATEMENT OF PROBLEM:

A century old fire exclusion policy has dramatically altered the giant sequoia (Sequoiadendron giganteum) groves in Yosemite National Park. Overprotection from natural fires has led to a denser canopy; dense, stagnant thickets in the understory; large accumulations of fuels on the forest floor; and species shift toward shade-tolerant trees with declines in shrubs and herbs. The natural condition and subsequent human-induced changes are documented by a series of photographs. A federal mandate dictates preservation of the Park's biotic communities. Furthermore, all natural processes are to operate freely, providing no species or biotic community is threatened with extinction, no unacceptable resource losses are anticipated, and human safety is not threatened. The Park faces the dual problem of reducing fuels to prevent the occurrence of conflagrations and restoring vegetation and wildlife to a more natural condition.

Accessory human-caused impacts to the sequoia groves are: soil compaction; root pruning; erosion of litter, duff, and top soil; disruption of natural drainage patterns; vandalism and injury by climbing on individual trees; and introduction of root rots and exotic plants.

Over 20 years of research on giant sequoia grove ecosystems has provided sufficient knowledge to justify an active vegetation restoration program. However, critical ecological information is still lacking and must be collected in order to prudently manage this biotic community over the long term.

To rectify ecological imbalances, the natural roles of fire need to be restored to the giant sequoia ecosystem. These roles are: setting back plant succession; providing a mosaic of age classes and vegetation types; reducing fire hazard; preparing seedbeds; recycling nutrients; providing conditions favorable for wildlife; and reducing trees susceptible to insect and disease attacks.

Frequent moderate-intensity ground fires, necessary to prepare a mineral soil seed bed, are by far the most common natural fire type in the groves. Presnall (1933) identified at least 14 natural fires in the Mariposa Grove since 1622--an average of one fire every 24 years. Undoubtedly there were other fires during this period that were not evident on his study trees. Biswell (1961) found that fires occurred an average of one every 2.3 years on a sequoia tract in neighboring Stanislaus National Forest. He also determined that 36 lightning fires were suppressed in the Mariposa Grove and 39 in the Tuolumne Grove during a recent nine year period. Crown fires were found to be uncommon; only one sequoia snag in the Mariposa Grove shows evidence of crown fire caused death.

Although, early Park managers were concerned about unnatural fuel accumulations in the groves, a superintendent in 1932 decided to allow fuels to continue accumulating for two reasons: piling and burning were costly and ephemeral; and some "nature lovers" viewed any management as interference with natural processes. During this period, the only deviation from this hands-off program was a vista-clearing operation undertaken during the Emergency Conservation Program in 1934 and 1935 which was not designed for fuel reduction. Until 11 years ago the last specific effort to reduce fuels was by the Army between 1911 and 1915 in several Upper Mariposa Grove locations.

Since 1970, CYA and YCC groups have manually removed 80% of the unnatural understory tree intrusion in the Upper Mariposa Grove and in all of the Tuolumne Grove. Understory trees were removed by cutting, piling, and burning; such clearing constituted the first step in restoring natural conditions. Very little work has been done in the Lower Mariposa Grove. Broadcast prescribed burning and 3 acres of clearing and windrowing has taken place in the Merced Grove. Prescribed fires have burned 50% of the Tuolumne Grove and 83% of the Merced Grove. About 205 acres within and 300 acres of buffer strip outside the groves remain to be treated by understory cutting, piling, and burning. The dangers are less from wildfires originating within the grove than from the outside. Present conditions jeopardize the safety of giant sequoia trees of every age class should an uncontrollable wildfire occur.

Current understory composition and duff and litter accumulation are symptomatic of a successional trend toward climax. The giant sequoia is a "fire-climax" species--depending on fire to set succession back to an earlier stage. Frequent surface fires and the resultant gap regeneration cycle produce a mosaic containing numerous age and species aggregations. Fire exclusion has begun a process that is destroying natural tree and shrub aggregations. The longer this fire-free environment persists, the more nebulous the vegetative aggregations will become and the more difficult will be the job of restoring a natural mosaic.

The uniform increase of other conifers in and adjacent to the sequoia groves has provided a live fuel ladder and increased the total fuel load. With heavy fuel accumulations below, chances of holocaustic fire capable of destroying an entire grove are possible.

Scattered dense fuel loads may be critical to grove ecology. Sporadic, heavy fuel accumulations may contribute to patch distribution of giant sequoia within the grove; intense fires are necessary to open the canopy, otherwise shade killing of young sequoias may leave only old sequoias as successional relicts surrounded by shade-tolerant white fir. Distinct groves of giant sequoia within mixed conifer forests make them important biologically and aesthetically. Crowding in among giant sequoia, white fir and incense cedar veil historic vistas.

Giant sequoia regeneration is presently very low mainly due to the absence of frequent fires critical for release, germination, and seedling development. Sequoias have evolved two reproductive strategies: repeated and explosive reproduction. Repeated reproduction is the slow annual release of seeds, few of which survive. Explosive reproduction follows a fire when super-heated air may cause cone death. Millions of seeds fall on ground cleared of litter and duff, readily germinating on optimal substrate. Allelopathic cone pigments that may delay and reduce germination success are destroyed by high temperatures during fires. The benefits of explosive reproduction are greater seedling establishment and grove expansion.

Dessication is the major termination factor for most seedlings. In unburned areas, wet litter is a good germination medium but is also a medium for pathogenic fungi; however, litter is rarely wet and drys quickly so seedling establishment is uncommon. Exposed, highly heated soil is more wettable (Donaghey 1969, Harvey and others 1980) and seedling survival is more likely on burned areas. The friable nature of burned soil readily permits seed and root penetration (Harvey and others 1980). The dirth of young sequoias is mainly due to a lack of suitably prepared seedbeds that result from frequent fires.

Fire eliminates many shade tolerant trees that compete with sequoias for soil moisture, nutrients, and light. Fire induced nutrient cycling increases seedling germination and survival. Fire speeds up the process of decomposition by reducing litter and debris to ash and increasing the supply of available nitrogen, phosphorus, potassium, calcium, and magnesium. However, total soil nitrogen declines through volatilization. Whether the increased depletion rate of soil moisture and nutrients in unburned areas will prove detrimental to mature sequoias is unknown but probable. Increased irradiation of sequoia seedlings by understory removal may be necessary for their widespread survival. To date, the intensity of most prescribed fires in the groves has been insufficient to remove a large percentage of the understory thus threatening widespread seedling and even grove survival unless it is removed by cutting.

Most grove vertebrates have little or no effect on the sequoias. Those that have any effect are usually beneficial. Immediately after a fire, however, herbivores readily devour the abundant seedlings. Vertebrates are not greatly affected by fire; their numbers fluctuate from many environmental factors other than fire (Harvey and others 1980). Small patchy fires provide a variety of environments favorable to wildlife.

Giant sequoias suffer from many detrimental pathogens and fungi. For example, a Penicillium sp. has been found that produces necrosis of the hypocotyl in giant sequoia seedlings (Swift 1975). Hot fires kill this seedling fungi and many other pathogens. Some beneficial endomycorrhizal fungi associated with giant sequoia may also be killed by hot fires.

Human-caused impacts in the groves include the introduction of exotic plants. Two noxious exotics--bull thistle (Cirsium vulgare) and common mullein (Verbascum thapsus)--have successfully invaded the Mariposa Grove. Although of limited biological significance, this situation offers two potential problems: 1) hand eradication might do minor damage to giant sequoia surficial roots and 2) prescribed fires, necessary for grove restoration, would have to be curtailed because exotics quickly establish themselves on recently burned areas, compounding the problem.

Meinecke (1926, 1927) reported that heavy sequoia grove visitation compacted the soil, threatening the existence of popular sequoias. A three-year study by Hartesveldt (1964) showed that Meinecke's fears were true but that environmental changes affecting sequoia regeneration are of much greater significance. Trampling and soil compaction are most evident at focal points in the Mariposa Grove. The Tuolumne and Merced Groves are less accessible and less heavily impacted. Trampling has caused some root pruning. Compacted soil inhibits seedling root penetration and affects established tree root respiration by reducing soil porosity. Excessive accumulations of CO_2 and other toxic substances diminish tree vigor. Compacted soils in the Merced Grove have not made a significant return toward their native bulk densities simply through removal of the compacting forces (Hartesveldt 1964). The soil loosening process must be aided by human effort.

Construction of roadways, trails, parking lots, and buildings has caused unnatural growth changes in sequoias. Construction caused root pruning resulted in a growth reduction on the affected side followed by a growth increase even though the total rooting area did not seem to increase; such an abnormally structured tree might fail sooner than it naturally would.

A considerable amount of sequoia root systems have been covered by impervious pavement where rain water accumulates, often causing gullying. The presence of pavement seems to have two varying effects on sequoias: it hampers water infiltration and prevents normal evaporation. Growth of the affected sequoia is greater due to water availability throughout the growing season. However, improper aeration may encourage the growth of pathogenic fungi (Hartesveldt 1964). Recent studies specifically implicate annosus rot (Heterobasidion annosum) in many giant sequoia root failures.

Additional impact sustained by the sequoias is caused by visitors climbing on roots and basal swells. Repeated clambering on the basal swell injures the tree; constant abrasion can expose and kill living tissue.

Two types of accelerated erosion have been identified in the Mariposa Grove: 1) sheet erosion due to foot traffic, and 2) gully erosion. By photographic comparison of trees, Hartesveldt (1964) has shown sheet erosion in several local areas where the surface litter has been pulverized and/or eroded away. The consequence of sheet erosion are: an increased evaporation rate from the soil surface; sequoia seedling germination and survival is low on these dry eroded surfaces and further foot traffic eliminates them entirely. Widespread lateral root exposure at varying distances from tree bases attests to widespread sheet erosion. Even sizeable main lateral roots have suffered scuffing damage to bark and cambium. The net effect is to lessen tree stability.

No Park sequoia has apparently fallen or otherwise died directly because of soil compaction, basal swell injuries, root pruning, fungal infestation, or erosion. There is cause for concern, however; an increased rate of tree failure has been observed since aboriginal time, and tree failure is hazardous to humans and property.

Vandalism has had minor impact upon giant sequoia groves. Three trees in the Mariposa Grove were cut prior to 1857; two of these have since been consumed by fires. A rare form of vandalism practiced today is the removal of large slabs of bark. From a biological point of view there is no harm to the tree; physically, however, the tree is deprived of its fire defense. In the event of prescribed burns the trees would have to be individually protected--a costly and unfortunate action. The most prevalent form of vandalism is carving on the exposed wood and bark of both living and fallen sequoias. Aesthetically this is undesirable. Also, souvenir collectors often vandalize sequoia wood and cones.

Implementing the National Park Service's 1968 administrative policy to maintain or recreate "the condition that prevailed when the area was just visited by the white man" requires a comprehensive understanding of the structure and dynamics of the giant sequoia ecosystem. Recreating the appearance of presettlement vegetation alone does not preserve a primeval mixed conifer-sequoia forest ecosystem; management must simulate ecosystem processes and remove impact sources. Restoring processes such as fire requires a quantified description of how the processes operated.

3. ALTERNATIVE ACTIONS AND THEIR PROBABLE IMPACTS:

A. No Action: This alternative would require no restorative management or mitigation of visitor, construction, or management impacts. All natural fires would be allowed in the groves.

The benefits of a no action alternative are reduced costs for Park operations. This alternative, however, is not feasible because a unique biological and historic resource would be seriously jeopardized--a Park Service directive violation.

Under this alternative the present condition of unnatural accumulations of live and dead fuels would increase until an intense and uncontrollable wildfire occurred. Such a wildfire would present significant risks to visitors, Park employees, facilities, and the groves' continued existence. Incredibly intense fires could dramatically alter the precise biotic composition of the groves, returning them to a very early state of succession. This kind of oscillation would be unnatural and contrary to management objectives.

The absence of frequent surface fires would cause declines in shrubs and forbs and successional advance to shade-tolerant species. Increased understory growth would reduce water tables, impair seed germination, and promote disease innoculation. Sequoia regeneration would be negligible without suitably prepared seedbeds and nutrient recycling would be slow. The giant sequoia would eventually disappear from the ecosystem--replaced by fire-intolerant species.

Individual trees may be killed by human-caused soil compaction, root pruning, erosion, bole wounding, and disease introduction.

B. Manually Remove Understory Trees: All natural fires within the groves would be suppressed. Understory trees would be selectively removed by cutting, piling, and burning. An environmental assessment with negative declaration pertaining to these activities has been approved by the Regional Director on December 9, 1977. Any of this work that will affect cultural resources would have proper clearance before work begins.

A benefit of this alternative is removal of the live fuel ladder, thus reducing the possibility of uncontrollable wildfire in giant sequoia groves and improving scenic vistas.

However, this alternative would neither open the crown canopy to the penetration of light nor effect soil conditioning for optimum sequoia regeneration; sequoia regeneration would by negligible. Eventually the giant sequoia groves would contain only senescent trees in an environment incapable of supporting younger trees to perpetuate the species.

C. Restore the "Presettlement" Condition and Maintain it in that State Strictly through Manipulation: This alternative would continue park and resources management programs of natural fire exclusion and restore the giant sequoia groves through whatever silvicultural practices might be necessary to check and correct unnatural shifts. Major corrective actions would be cutting, piling, and burning, followed by prescribed fires.

A benefit of a prescribed fire action plan are removal of unnatural fuel accumulations. Prescribed fires offer control of timing, intensity, and extent of impact through proper choice of prescription. Where fire intensities are low, effects are limited principally to the understory, but under dry conditions the overstory would also be affected on those sites where fuel loads are high and vertical distribution is continuous. Where there are intense fires some of the canopy will be removed, forb and herb growth would be improved, and sequoias would more successfully regenerate. The natural age and species aggregates would be simulated. Disease innoculation by such agents as annosus rot will be reduced.

After restoration, it is highly improbable that sequoia groves can be maintained in their "presettlement" condition. Research by Bonnicksen and Stone (1978) has shown that presettlement groves were not in a steady-state condition and it is biologically infeasible to maintain a static forest structure. Change is an ecological rule and uneducated manipulation of sequoia groves could irreparably alter their natural course of evolution.

D. Manipulate the Vegetation by the Use of Fire to Restore the Natural Condition: This alternative would allow cutting, piling, burning, and prescribed fire to restore sequoia groves; and natural fire would be permitted following these manipulations. Management actions would be based on ecological principles so long as no species or biotic community is exposed to the possibility of extinction, no unacceptable losses to other resources are anticipated and human safety is not threatened.

Natural fire effects are similar to those described in alternative "C" for prescribed fire. Fire intensities would vary such that an occasional tree might be lost--a natural event. Natural fire would be permitted only in low-fuel accumulation areas and where there are natural and existing man-made fire breaks, thus limiting the intensity and extent of detrimental impacts. To further limit the possibility of escape, buffer zones would be created by prescribed burning at grove boundaries. Natural fires recreate the natural vegetative mosaic where fire-adapted and fire-intolerant species of all age classes occur together. Benefits of this action would be the same as for alternative "C" with additional benefits derived from natural fire.

E. Research: The effects of management actions and human-caused impacts would be monitored. Fire research would determine whether prescribed fires are beneficial or harmful to the groves. If prescribed fires prove to be beneficial, fire history research would determine fire intensity and fire frequency desired for prescribed burns. Prescription development would enable managers to accurately simulate natural fires.

Research would elucidate the dynamic properties of the groves, and the processes which brought about these changes, as they operated prior to the influence of European man. Giant sequoia grove species and age aggregates and their relationship to fire, light, fungi, pathogens, soil, and drainage patterns would be (to the extent feasible) qualitatively and quantitatively documented by an ecological study of the groves.

A vegetation inventory of species density, composition, and structure would be an essential component of this ecological survey. The potential for grove retreat or expansion would be assayed in this study as well. Comparison of the survey data with historic records and photographs would direct grove restoration. If management actions are not based on sound information, effective sequoia grove restoration and perpetuation of the sequoia biotic community is uncertain.

F. Alleviate Deleterious Impact From Human Activities: To mitigate human-caused impacts: compacted soil would be manually loosened; unnecessary and detrimental trails removed or rerouted; abandoned roadways, buildings and parking lots removed; native topsoil replaced; natural drainage patterns reestablished; trails redirected away from the immediate vicinity of sequoias; unobtrusive barriers constructed around severely injured sequoias; and exotic plants eradicated.

This alternative would insure preservation of individual giant sequoia trees but it would fail to perpetuate the sequoia biotic community. The phenomenon of isolated and aging trees, growing in a habitat devoid of their progeny is contrary to Park management objectives.

4. RECOMMENDED COURSE OF ACTION:

Alternatives A, B, and C are rejected for reasons stated in their respective sections. The recommended course of action is a combination of alternatives D, E, and F, which would assure restoration of natural conditions and preservation of the natural processes that operate in the sequoia biotic community. If any of these actions were implemented individually, they would fail to maintain natural processes in violation of policy directives. The benefits of this action course are a management program based on quantitative research--enabling managers to effectively implement, monitor, and evaluate their activities. By reintroducing fires' role into this ecosystem, fire hazards are removed and inherent age and species aggregations are maintained. Sequoias would successfully regenerate and be resistant to disease innoculation. After natural conditions have been restored natural fires would maintain the groves in a dynamic state. Historic scenes would be recreated, enhancing visitor enjoyment of the Park, and wildlife habitat would improve. Human-induced impacts, such as soil compaction, root pruning, drainage disruption, vandalism, and exotic plant establishment would be corrected by removal of the impacting forces. All restorative activities will have proper cultural resources clearance before work begins.

5. FUNDING:

A. Recurrent Funds Available in Park Base..............$ None

B. O.N.P.S. Funds Requested...........................$35,500.00

1. YOSE-N5-BLACK OAK WOODLAND RESTORATION

2. STATEMENT OF PROBLEM:

California black oak (Quercus kelloggii) woodlands are vanishing in Yosemite National Park. Before the Park's inception, naturally occurring and aboriginal fires created an environment in Yosemite Valley and other canyon-bottom sites that favored the establishment and maintenance of black oak-conifer-meadow complex; European man has shifted this complex to dense conifer-dominated forests. Maintenance of current conditions and vegetative trends is contrary to management objectives of maintaining natural processes and natural vegetative cover, and will result in the eventual replacement of all Park black oak woodlands.

Human-created ecological aberrances of the presettlement black oak-mixed conifer woodlands include: over 100 years of fire suppression leading to an unnatural build-up of fuels, proliferation of a dense coniferous understory and acceleration of plant succession. These responses were augmented by removal of the terminal moraine in Yosemite Valley in 1879 and subsequent channelization of the Merced River to protect roads and facilities. Ecologically, the California black oak woodland is important wildlife habitat and valuable in watershed protection. Aesthetically, the presence of black oak woodlands add to the unique character of Park forests--especially in Yosemite Valley.

The presettlement Yosemite Valley tree population was composed of two distinct age groups: intermediate-age black oak; and old-growth stands of primarily black oak, with scattered individuals of ponderosa pine, incense-cedar, white fir, and Douglas-fir. Aboriginal burning prevented coniferous forest encroachment and arrested plant succession at the black oak woodland stage. Indians wished to maintain black oak woodlands since black oak acorns were a major food source. Valley Indians continued their annual burning until 1865.

> After 1870 the spread of trees and shrubs was increasingly influenced by the activities of man. Cultivated areas were kept free of young trees, and loss of valuable grazing land led to more clearing efforts. During the seasons of 1891 and 1892, men were employed to thin some of the thickets of young pines and cedars and clean up combustible material; about 150 acres were partially reclaimed. More clearing was done during 1897 or 1898, and practically every annual report during the early years of the Army administration mentions the need for clearing in the Valley, although little seems to have been done until 1911 when some undergrowth was removed.
>
> Gibbens & Heady 1964

In early Park days, black oak woodlands afforded scenic and historic views to the visiting public. Present day vistas are far from the presettlement scene when black oak woodlands framed the Valley's geologic and hydrologic features. Limited vista clearing was carried out by early settlers in Yosemite Valley prior to 1880.
It was a regular activity during the 1930's C.C.C. period and in a more limited manner up to 1961, when priorities changed. Since the 1940's, funding for this activity has been extremely limited. Reduced stand density brought about by restorative thinning should create a more open stand with a longer Valley view and hence be more pleasing aesthetically.

Although the first Park superintendents were aware of vegetative shifts away from black oak woodlands, presettlement vegetative restoration was not a resource management objective. Park superintendents operated with intentions to make the woodlands safer from the standpoint of fire and also produce a pleasing landscape effect. Some understory thinning and vista-clearing was done between 1914 and the 1970's. Black oak woodlands were mapped in the 1930's. The most extensive restorative work done to date has been the prescribed burning of 945 acres (21 percent) of the Valley floor. Some areas have burned more than once.

Enclosed study plots were established in the 1930's to assess herbaceous and black oak regeneration. In 1952, Park Forester Ernst noted that black oak seedling development was considerably greater inside the enclosures than outside even though ecological conditions were similar. Taylor (1969) studied five enclosed and five control black oak seedling survival plots. The study plots were placed in five differing Valley locations. Conclusions from his studies were: visitor trampling was a significant seedling mortality factor; insect impact was greater on unenclosed oak seedlings; there was no evidence of deer or rodent activity in or around the sites at the time of observation (late September); few seedlings were older than seven or eight years; oak seedlings and saplings seemed suppressed; shade seemed to have no bearing on seed germination and seedling survival, but probably had a significant bearing on plant development beyond seedling stages; most mature black oaks were being over-topped by vigorous, young coniferous growth; most conifers among the black oaks were 80 years or younger; and black oak was clearly not the climax species in the areas observed. Most of Taylor's observations are consonant with other studies and current observations and may be valuable as restorative guidelines for black oak woodlands.

California black oak thrives on a wide range of sites. It grows vigorously on deep, well-drained, acid to moderately acid soils of loam or clay-loam texture and does well on sandy, gravelly, or stoney soils. Poorly drained soils restrict downward root penetration and lead to early demise. Black oak often occurs on the poorer, harsher sites where black oak stands tend toward purity. However, its best development is on sites where conifers are more competitive and hence responsible for eventually reducing oak density (Tappeiner and McDonald 1979).

Black oaks may promote the establishment, early survival, and growth of conifers by creating a more favorable soil pH and sheltering them from dessicating sunlight. Black oak shade and leaf litter often ameliorate soil temperature and moisture during the growing season, allowing dense conifer clumps to develop vigorously in the understory. Eventually, black oaks are over-topped on the best substrates and remain only as scattered remnants in dense mixed-conifer forests. These trees often exist on soil "islands" unfavorable for conifers. Moisture stress is likely on these poorer sites, but Waring (1969) has found that black oaks weather severe transpirational stress quite well.

Black oak is intolerant of competition throughout most of its life, but its reaction to shade varies with age. It endures moderate shade in early life. As a sapling and small pole, it is less tolerant and often rapidly elongates in an attempt to reach a canopy position where it can receive overhead light. Should the young oak be overtopped, it either dies outright or dies back 1/3 to 3/4 the total bole length, and the living remainder produces a few short epicormic branches. These branches may keep the tree alive for some time, but continued overtopping results in death (Tappeiner and McDonald 1979). Suppressed black oaks are capable of large and rapid growth increases when freed from the overstory. If broadcast overtopping continues in Yosemite Valley, black oak woodlands will cease to exist.

Fire increases the prevalence of California black oaks and vegetative associates (Biswell et.al., 1966; Horton 1960; Soc. Amer. Foresters 1954). Most black oak stands originate from sprouts--an evolutionary adaptation to the presence of fire. Black oak's capacity for vigorous, abundant post-fire sprouting reduces soil erosion, provides browse for wildlife, and protects valuable watersheds. Fire may reduce coniferous competition and result in more vigorous and better formed seedling sprouts. Fire kills oak seedlings to ground level; the root crown sprouts--often with only one stem. These fire induced oak sprouts attain height faster than seedling conifers and in two years grow beyond browse height and competitive bonds. While height growth is relatively fast following fire, diameter growth tends to be slow during the first 25 years of life. Black oak seldom exceeds five feet in diameter or 130 feet in height. The largest black oak recorded has a 36 foot circumference and grows in Yosemite (Dixon 1961).

Fire can have a negative impact on black oaks. "California black oak is severely damaged by crown fires and unless mature, even by relatively cool ground fires" (McDonald 1969). Fire can kill or damage stems. Fire damaged stems are especially susceptible to pathogens which weaken the tree and result in windthrow and breakage. Older trees are especially susceptible to structural collapse as fire burns out their interiors which are frequently rotten and/or hollow. A number of wood-rotting fungi attack black oak trees; *Armillaria mellea* being particularly harmful. Black oaks are often afflicted by several leaf diseases and a mistletoe; individual trees usually survive an infestation, but growth and vigor loss can be expected. Many insects are parasitic on black oaks; however, their damage is usually secondary--reducing growth but seldom killing the tree.

Black oak woodlands are critical habitat to several wildlife species. The replacement of black oak woodlands by conifers is reducing acorn production to very low levels; acorns are an essential food source for at least 14 bird species, many small mammals (mostly rodents), bears, and deer. Deer consume acorns year round--depending on them in the winter when other foods are scarce. Deer also browse on black oak foliage.

Black oak regeneration has been scanty in the last 80 years despite adequate viable seed production. The Park's numerous old and productive trees are not being replaced by their progeny.

Immediate research and manipulation are necessary to restore the ecological balance that existed in the Park's presettlement black oak woodlands. Black oak woodland restoration requires a thorough understanding of the benefits and impacts of fire and the development of a management target.

3. ALTERNATIVE ACTIONS AND THEIR PROBABLE IMPACTS:

A. No Action: Under the no action alternative black oak woodlands would continue a natural succession toward dense mixed-conifer forests.

The black oak woodlands would probably cease to exist in the next fifty years as conifers would suppress the mature oaks, out-compete the oak seedlings, and dominate the overstory, eventually killing sapling and pole oaks. Eventually, the conifers would probably be attacked by annosus rot (*Heterobasidion annosum*); by the time annosus rot returns the conifers to a more natural density, the black oak woodland community would be destroyed. Infected trees might damage physical facilities, cause injuries, and might cause loss of life.

The absence of fire in the black oak community would reduce forage for wildlife due to successional advances toward a "climax" forest. The overgrowth of trees and established shrubs tends to store energy beyond the reach of wildlife. Wildlife would be less diverse and deer populations would probably decrease. Decreased bear food could augment the number of human-bear encounters.

Black oak woodlands would show larger and larger deviations from its pristine condition with eventual impact on the potential for visitor enjoyment. Historic views and scenic vistas would be few; cultural sites would be more difficult to locate; dense thickets would be impenetrable and pose fire threats.

An immediate advantage of this alternative would be reduced costs for resources management programs. Management objectives require the maintenance of all biotic communities within the Park. A no action plan would seriously jeopardize black oak woodlands and is therefore contrary to Park management objectives.

B. Mechanically Remove Coniferous Understory Trees: Under this alternative conifers invading formerly pristine black oak woodlands would be mechanically removed by resources management crews and organized work corps such as C.C.C.

Understory thinning in California black oak woodlands would: reduce black oak/conifer competition for nutrients, moisture, and sunlight; remove threatening live fuel ladders; halt accelerated succession towards coniferous forests; attenuate fungal diseases; reduce evapotranspiration; and restore many historic views and scenic vistas. Increased sunlight and available moisture would enhance black oak growth and reproduction. Understory thinning would reduce annosus rot infestion in remaining conifers. Fuel ladder elimination would permit the use of prescribed fires that set back succession and favor black oak regeneration. All of these effects would tend to recreate presettlement black oak woodlands, and their associated scenic values. Removed trees would provide park visitors with fuel wood.

This alternative action has limitations; restorative activities might be sporadic and limited to small areas because of job magnitude and high labor costs. Adverse impacts would be temporary aesthetic drawbacks of slash pile-ups, chainsaw noise, and logging crews. Some nutrients would be removed from the ecosystem along with the understory trees.

C. Remove Coniferous Understory Trees by Prescribed Fire: Under this alternative, prescribed fire, a natural element of black oak woodland communities, would selectively reduce understory encroachment. Prescribed burning in black oak woodland's of Yosemite Valley is already being carried out within units designated in the Park's Natural, Conditional, and Prescribed Fire Management Plan (1979).

The absence of fire makes restoring the presettlement black oak woodlands virtually impossible. Prescribed fire would remove dense, stagnant understory conifer thickets and unnatural fuel accumulation; shift the vegetative mosaic to favor black oak; increase nutrient-rich wildlife browse and forage; reduce forest diseases; recycle nutrients; increase seed production and sprouting; and create more open and varied vistas. Fire would affect larger total areas and accomplish more fuel reduction, successional alteration, and other restorative measures than would implementation of a strictly mechanical tree removal program. Mechanical tree removal, however, would always be necessary in some areas to substitute for prescribed burn restrictions and to remove large trees.

Visitor enjoyment of scenic views would be temporarily reduced due to smoke interference; and air would be polluted with more particulates. Recent cultural artifacts of a combustible nature, unidentifiable due to dense ground cover, might be destroyed by fire.

D. Research: To perpetuate the Park's black oak woodlands a vegetation survey and gradient model of the park's plant communities is needed. Research would identify critical black oak woodland survival factors and use this ecological information in conjunction with the vegetation survey to infer geographic locations of black oak stands in various stages of deterioration. This baseline survey would guide restorative activities.

Additional research would elucidate fire's ecological role in black oak woodlands. If fire proves beneficial, burn prescriptions that offer control of fire intensity and frequency for maximum black oak woodland regeneration and maintenance would be developed. Conifer-dominated forests of historic black oak woodlands may require relatively intense fires to open the canopy--thereby encouraging black oak maturation. Black oak woodlands could disappear as a result of uninformed management practices.

4. RECOMMENDED COURSE OF ACTION:

The recommended course of action is a combination of prescribed burning (C) and selective manual conifer removal (B) together with vital ecological research to guide restorative actions (D). Current monitoring of prescribed burn areas has shown an increasing prevalence of black oak in the understory. This trend might in time restore some areas of black oak woodland. In areas where the conifer canopy is dense and cannot be affected by prescribed burning, some tree removal would be necessary to release suppressed black oaks. Successful bark beetle attacks on pines and annosus rot on all conifer species might facilitate this process by selectively removing large trees from the canopy. Prescribed burn prescriptions and rotations would be refined to insure the establishment of seedling black oaks in the understory. To maintain a typically open black oak woodland very few oaks need to reach maturity.

An environmental assessment with negative declaration pertaining to understory removal by manual means and prescribed fire has been approved by the Regional Director on December 9, 1977. Any of the restorative work that could affect cultural resources would have proper clearance before work begins.

5. FUNDING:

A. Recurrent Funds Available in Park Base..............$ None

B. O.N.P.S. Funds Requested............................$33,500.00

1. YOSE-N6-MEADOW RESTORATION BY TRAIL RECONSTRUCTION

2. STATEMENT OF PROBLEM:

Many meadows within Yosemite National Park are deteriorating as a result of improperly designed, located and/or maintained trails. These meadows suffer from: trampled sod; rutting and parallel trails; accelerated erosion; and alteration of drainage and soil moisture regimes. All of these physical changes have affected the native vegetation and are threatening the existence of many meadows. Federal law mandates preservation of the Park's meadow resource.

Park meadows are an intrinsically valuable wilderness ecosystem and an immensely popular stopping place for Park visitors. Although meadows comprise only 10 percent of the Sierran vegetative cover, this small area provides the bulk of wildlife forage. Meadows filter sediments from runoff water, providing clean water for human and wildlife consumption and suitable fish habitat in lakes and streams. Meadows are also highly aesthetic and provide scenic diversity.

Improperly constructed and unmaintained trails through wilderness meadows cause a series of destructive events: hikers and stock physically alter meadows by trampling vegetation and compacting soil; this accelerates erosion and disrupts the natural water distribution patterns. Edaphically and hydrologically altered meadows succumb easily to exotic plant invasion or to a few stresstolerant native species. Low-elevation meadows are especially susceptible to exotic plant invasion. Eventually the drier meadow becomes a forest, permanently altering its ability to return to a meadow condition. Exotic plant establishment is rare in alpine and subalpine meadows due to the extreme adaptive requirements of this environment.

Bare spots, and replacement of the original vegetation by patches of "weedy" species, are the first evidence of user-caused meadow impact. Violation of the protective mantle of meadow sod causes the thin, fertile top soil to blow or wash away from among the remaining clumps of vegetation--exposing the underlying sand and gravel. The sandy soil, no longer bound together by tightly interlaced rootlets, dries, loosens, and favors not only further weed advancement, but also seedling germination from the encroaching forest.

Trails and adjacent bare spots become runoff channels particularly in the spring. Meadow impact during this time of year is intensified because travelers, avoiding muddy, wet trails, move onto the drier sod adjacent to the trail, crushing and tearing sod out from the loose, water-laden soil. As time progresses many parallel trails form and erosion accelerates. In general, boggy basin meadows and wet low elevation meadows, such as in Yosemite Valley, are more resilient than alpine and subalpine meadows, which have a short growing season and are steeply sloping.

The amount of impact on high Sierran meadows relates closely to their strategic importance as stopping places. With tremendous increases in use, Park meadows most important for hikers and aesthetics are now the most endangered. The popularity of crosscountry hiking and skiing, and use of unofficial trails in the last ten years, has resulted in serious impact to many alpine and subalpine meadows.

In the past, popular solutions to meadow erosion from trails was to limit stock use (stock does proportionately more damage than equal numbers of hikers) and reroute trails around meadows. Neither solution has been successful. Limiting the total number of all user types and their time of use is more critical than limiting stock use levels. Rerouting proved to be expensive, created new erosion problems, and impacted another area unnecessarily. According to Jim Snyder, a Park trail foreman for 16 years, reroutes failed because reroute planners did not consider why the trail was originally put in the meadow (for instance--the most direct route to a destination) and reroute construction included no real effort to restore damaged meadows simultaneously. The trail through Rafferty Meadow, for example, was rerouted through the forest but the old trail was not camouflaged and offered easier and snowfree access when forest trails are still snow-covered so both trails are now used. Gullying of this meadow was never corrected so meadow deterioration continues. Snyder's observations and experience show that rerouting is "rarely necessary" and that "work should be concentrated most often on repairing the old trail correctly in the first place". Due to a chronic shortage of funds, trails maintenance and soil stabilization work on abandoned trails has been inadequate for years.

Where the natural hydrological characteristics of a deteriorated meadow are known, it is possible to take actions that will reestablish those characteristics. Drainage basin area and slope largely influence gully formation and are therefore critical considerations for meadow trail design and construction. Primitive check dams and live willow cuttings have successfully restored the original stream gradient in the badly impacted Wawona Meadow. Crushed rock causeways that do not restrict water flow have been successful in damaged meadows. A causeway constructed at Tuolumne Pass in 1975, and a roman-arch causeway constructed at Glen Aulin in 1976, were extremely successful restorative measures in these areas.

Vegetative response to restoration was dramatic at both of the above sites where gullies had altered meadow hydrology and set off changes in direction and rate of plant succession. Correction of hydrologic conditions in the Tuolumne Pass meadow, however, was not the only reason for success at this site. The old rutted trails were resodded with neighboring sod. Five techniques were tried-native sod worked best. According to Snyder, every deteriorated Park meadow can be restored by this resodding technique. Native seed-sowing on rutted trails, though cheaper, can fail due to seed propagation problems.

Lemons (1976) and Sharsmith (1961) each studied ecological changes as related to visitor use levels in several Park meadows. Both concluded that the native vegetation had altered in high use meadows. Lemon found that meadow vegetation reacted to trampling stress by simplification and the selection of a few dominants. Sharsmith found that the vegetal components of the overused meadows were clearly deteriorated from their natural state. He feared that this vegetative trend would be irreversible. He also noted that records of the pristine meadow state are lacking, yet essential to their restoration and management.

An early Park naturalist wrote a narrative description by which the Park can model its restorative efforts. The pristine Sierran meadow of the nineteenth century looked to John Muir like this:

> The general surface is nearly as level as the lake which it has replaced, and is perfectly free from rock-heaps and the frowsy roughness of rank, coarse-leafed, weedy, or shrubby vegetation. The sod is close and silky, and so complete that you cannot see the ground; warm also, and everywhere free from mossy bogginess; and so brilliantly enameled with flowers and butterflies that it may well be called a garden-meadow, or meadow-garden; for the plushy sod is in many places so crowed with gentians, daisies, ivesias, and various species of orthocarpus that the grass is scarce noticeable, while in others the flowers are only pricked in here and there singly, or in small ornamental rosettes.

At best, our mountain meadows are limited in number and many will gradually, though very slowly, evolve naturally into forests. However, this slow process has become unnaturally accelerated by overuse on improperly designed, located and/or constructed trails. Although technical information for meadow restoration by trail reconstruction exists, the Park's trail crews are unable to restore deteriorated meadows due to lack of time, funds, and humanpower. Of the Park's 750 miles of trail, at least 9.5 miles are in need of immediate reconstruction to insure meadow restoration.

3. <u>ALTERNATIVES ACTIONS AND THEIR PROBABLE IMPACTS:</u>

A. <u>No Action</u>: A no action alternative would require no government restorative efforts for Park meadows.

A benefit of this alternative would be reduced Park-operation costs.

Under this alternative, accelerated erosion would continue and meadow drainage patterns would alter so that meadows would become more dry, changing vegetative composition, structure, and density. Exotic plants introduced with horse feed would take advantage of the disturbed low-elevation meadows and replace many natives. Tree invasion of meadows would accelerate, and watershed values correspondingly diminish. Wildlife forage would decline and cause a loss of Park wildlife populations.

Meadow-inhabiting animals would suffer, and losses in aesthetic values would result. A no action alternative would violate a Federal mandate and Park Service policy.

B. Remove Invading Trees to Maintain Meadows: Park meadows would be maintained by manual removal of trees from encroaching forests. Existing trails would remain as they are.

A benefit of this alternative would be the continuing presence of Park meadows with some of their ecological and aesthetic values.

The artificial maintenance of deteriorated meadows would ignore the ecological processes that operate to perpetuate this ecosystem, with unforeseeable consequence to this biotic community. Since meadow restoration and trail reconstruction would not be the primary goal, accelerated erosion and meadow drainage disruption would continue causing changes in herbaceous species density and composition.

C. Seasonally Restrict Meadow Trail Use: Trail closures would restrict travel (in the spring and early summer) to sensitive deteriorated meadows with trail access. Meadow use would be restricted until meadows are sufficiently dry. Trails in forested areas skirting meadows would remain open. Protection patrols would enforce use restrictions. The Tioga Pass road would remain closed until Tuolumne Meadows dry out.

Benefits of this alternative would be reduced meadow impact during the most sensitive time of year. When meadows are saturated the fragility of the substrate and the potential for breaking through the turf also increases (Harvey and others 1972). Both of these can contribute to rut formation in meadows with erosion, possible water table depression, and associated meadow invasion by woody species. Use would occur when meadows are drier and less susceptible to this influence or on alternate trails through less fragile forest perimeters.

Trail use reduction in the spring and early summer would reduce total park use and possibly redistribute use to adjacent National Forest areas. Many visitors would be inconvenienced and disappointed by these broad use restrictions. The later opening of the Tioga Pass road would restrict travel into the Park, interfering with access from the east and potentially having economic impact on the region east of the Sierras such as Lee Vining, Bridgeport, and Bishop. Also, some decrease in concessioner revenue would result by the delayed opening of High Sierra camps.

D. Reroute Trails Out of Meadows: Trails would be constructed and maintained in other feasible locations around meadows. Meadow damage would heal over time by natural forces. Signs and barriers would be erected to direct travellers to the reroutes. Reroutes would have cultural resources clearance before construction.

Meadows would improve by reduced use; this would mean a reduction in direct user-caused impact such as trampling and the contagious proliferation of parallel trails.

Soil loss and gullying would continue to negatively affect water quality and meadow drainage patterns. Eventually the deteriorated meadows would be permanently and unnaturally altered. Vegetation and wildlife would be correspondingly altered. Experience has proven that rerouting alone often fails; existing meadow damage must be repaired and efforts must be made to thoroughly camouflage the old meadow trails. Reroutes are costly to construct and maintain.

E. Reconstruct Trails to Restore Meadows: Specially designed trails which allow for easy water passage from one side to the other would be constructed to handle traffic with the least environmental impact. Abandoned trails would be stabilized with water-bars and check dams. Parallel trails would be camouflaged by resodding with nearby sod. Unofficial trails resulting from heavy cross-country use would become part of the maintained trail system in order to stabilize or reduce impacts. All trails to be reconstructed will have cultural resources clearance before initiation of construction activities. Alternative actions will be taken where reconstruction work has the potential to endanger cultural resources.

Benefits are the construction of check dams and crushed rock causeways that eliminate ugly scars left by multiple trails and allow operation of the ecological processes that maintain meadows. Wildlife populations and water quality would be preserved. Visitor enjoyment of the wilderness and the Park would increase. The environmentally and structurally sound trails would reduce future maintenance costs.

A negative impact is high initial labor costs and therefore increased costs for Park operations.

F. Research: All meadows with official and/or unofficial trail access would be mapped and inventoried. Meadows would be placed in type catagories for prioritization of management needs. Classification would be dependant on meadow aspect, elevation, slope, soil type, drainage characteristics, and species density, composition, and structure. "Pristine" meadows would be quantitatively and qualitatively described and serve as models for restoration activities. Periodic vegetative surveys of resodded meadow trails would permit improvement or abandonment of resodding techniques. Data would be collected in meadows at various stages of restoration.

Adequate monitoring would permit competent evaluation and regulation to avoid such meadow degradation as erosion, altered drainage patterns, and adverse changes in vegetation composition and density. Without research, management activities can lead to meadow deterioration.

4. RECOMMENDED COURSE OF ACTION:

Alternative A is rejected because the Park's meadow resource would be irreversibly altered or totally eliminated. On a case-by-case basis, various combinations of alternatives B, C, D, E, and F would be implemented to restore and/or maintain Park meadows with trail access. The entire meadow trail system would be evaluated and restored from the standpoint of erosion and other adverse ecological influences. Management would stress evaluation and restoration of critical areas on a priority basis. From information collected on each impacted meadow, the Resources Management Division would develop and implement an action program designed to minimize and/or eliminate those undesirable situations. This would be accomplished by: trail rerouting, instituting alternate trails with interim "rest periods", occasional seasonal trail closures, intermittent placement of appropriate directional and interpretive signs, and trail reconstruction. Corrective measures would be primarily 9.5 miles of trail construction with annual trail maintenance and soil stabilization as required. Old, improperly located trails would be abandoned and the damaged meadows restored by placement of check dams and resodding; for such trails in level meadows, compacted soil would also be loosened. Where forest encroachment is a result of human impact, it would be forestalled by manual tree removal. Data would be collected to evaluate the effectiveness of restorative efforts.

The benefits of the recommended alternative are those described in alternatives B, C, D, E, and F.

The negative impact would be initial high labor costs.

5. FUNDING:

A. Recurrent Funds Available in Park Base..............$ None

B. O.N.P.S. Funds Requested.............................$77,000.00

NATURAL RESOURCES PROJECT STATEMENT

1. YOSE-N7-GRAZING MANAGEMENT

2. STATEMENT OF PROBLEM:

Grazing abuse has led to meadow deterioration in many Park meadows. Although Park meadow grazing is now greatly reduced, abused meadows are recovering slowly, recovering in a highly altered ecological state, or succeeding to forests. Some meadow areas are presently deteriorating further due to intense localized grazing and attendant trampling. Park management is mandated by federal law to protect its meadow resource and the natural processes that perpetuate them.

At present, on an average day in the backcountry, approximately 7 percent of the stock use is public use on either private or permittee packer stock. An additional 20 percent is National Park Service stock use. Park concessioner stock comprise 73 percent of the Park's total stock usage (van Wagtendonk pers. com.).

Since stock use represents only 0.7 percent of the total backcountry overnight use and is distributed over a large area, stock grazing has a relatively small impact on soil, water, and vegetation as a whole. In popular areas, however, stock are often concentrated and intensely graze and trample meadows creating significant ecological impacts. Improper drift fence placement may be partially responsible for localized stock overconcentration. Improperly staked or picketed stock has also led to site specific meadow impacts.

Cattle occasionally trespass the western boundary of the Park from adjacent portions of the Stanislaus and Sierra National Forests. The problem is serious in the vicinity of the Hodgdon Entrance Station, where cattle occasionally become hazards to motorists. Serious trampling occurs in the Merced Grove and near Chiquito Pass. East-side livestock trespass into Thompson Canyon and other backcountry areas causing meadow and trail damage and creating an undesired aesthetic intrusion.

Where trampling and overgrazing has physically altered meadows by punching holes in the ground cover and baring the soil, a variety of impacts occur: erosion and water table alteration cause species to change, exotic plants to supplant natives (except in the subalpine and alpine meadows), and woody vegetation to invade. Wood (1975) found that drainage basin area and meadow slope are related to meadow stability. Wood believes that livestock use of "unstable" meadows may be a prime factor for erosion and gullying. Many grazed Park meadows fall under this classification.

Heavy sheep grazing in the past has caused some ecological shifts in many lodgepole-bordered subalpine meadows. Soil degradation and water distribution alteration caused by this heavy grazing has accelerated meadow conversion to the regional climax--lodgepole forest. Past remedial actions included erosion control with check dams in gullies and removal of invading trees. These management actions were discontinued and their effects have not been systematically monitored.

Sharsmith (1961) found indications "that grazing along meadow forest fringes disturbs the topsoil, enhancing the encroachment of lodgepole seedlings." However, Walt Castle, the Park's animal packer foreman, has observed that grazed meadows display less forest encroachment than ungrazed meadows. No quantifiable studies have shown which is true, though both are possible and dependent on a particular meadow's physical and vegetative characteristics.

Research has shown that extensive meadow grazing can result in species elimination and environmental deterioration. Density and total volume of herbage are reduced; species shift from perennials to annuals, and changes occur in species distribution and relative abundance. Studies by Sharsmith (1961) have shown that "stock grazing is highly selective with regard to species chosen, sometimes resulting in the elimination of certain species, in favor of other species, often non-native." Generally, horses are the most selective (primarily grass) grazers, and are better able to utilize coarse forage. Burros and horses have a habit of pulling plants and eating only parts of them. While they do not naturally tend to congregate, confined horses can do more damage than any other livestock class (FS-PSW-1701-5). Low-elevation meadows are susceptible to exotic plant establishment but high-elevation meadows are resistant due to the extreme environmental forces at work at these elevations.

Meadows are particularly sensitive during the wet season. If travelled through at this time, the fragile, new-growth is easily cut and crushed. Early season grazing can also deplete root reserves and decrease meadow vegetation vigor. Stock use of backcountry meadows is curtailed in the wet seasons but occasional, seasonally premature travel continues to damage some meadows. The degree, frequency, and time of grazing or other defoliation caused by trampling are of fundamental importance in determining utilization standards.

Wildlife experiences habitat disturbance in areas regularly grazed by livestock, both directly and indirectly. Evidence indicates that mule deer does in Yosemite depend on meadows and thickets at meadow edges for birthing and postnatal care of fawns (Dixon 1934a). "It is conceivable that livestock use of meadows and meadow edges prior to fawning could make the preferred fawning sites undesirable. If so, such use may cause does to select less desirable sites as fawning habitat," (FS-PSW-1701-5) possibly reducing the native deer population. Changes in the vegetative composition due to grazing may have profound effects on much of the Park's wildlife; however, no research has been conducted to verify this.

The aesthetic impact of stock is generally restricted to a few meadows and several popular trails. Many hikers entirely object to stock and stock wastes in the wilderness; others condone stock. The most striking evidence of stock in the backcountry are overnight and day stock rides conducted by the Park concessioner. These rides are often on the most popular trails where many hikers object to the presence of manure and large concentrations of flies.

The use of stock in Yosemite precedes its genesis as a National Park. Explorers introduced stock into Yosemite in the mid-1800's, the cavalry regularly patrolled the area on horseback around the turn of the century, and both the Park Service and the concessioner have consistently made use of stock in their operations. In these ways, for the past 147 years stock have played a changing but always significant role in the private appreciation and public administration and maintenance of the Park (Stock Use Plan 1980).

In an effort to reduce stock caused impacts, grazing regulations have been in effect for several years, along with drift fences and signs. No Park stock have been pastured in the Deer Camp area since 1973. In 1974, all grazing of unused concession stock around Deer Camp, Bridalveil Meadow, and Little Yosemite Valley was discontinued. All government stock grazing in Big Meadow terminated in 1975. No follow-up study of the effects of these regulations has been made. All stock pasturage (except for government stock pasturage in Harden Lake Meadow) not incidental to a recreational or management trip ceased in 1977. This affected mostly concessioner activities particularly in Wawona Meadow. Extensive restorative work involving check dam installation, stock bridges, cross fences, study exclosures and willow plantings were carried out in Wawona Meadow in the 1930's.

Grazing by horses, mules, and burros in most backcountry areas is presently legitimate for government and public transportation of people and equipment to distant wilderness destinations. Harden Lake Meadow is the only site where government stock are permitted to regularly graze. Although all stock users are encouraged to pack complete rations for their animals, it is not required and considerable grazing takes place. At present, Park Service stock parties are grazed where the Parks' animal packer foreman believes the ecological impacts to be the least. The foreman has identified two problem situations: sites where stock grazing has been impeded by dead timber jams and sites where grazing would be detrimental due to the inherent fragility of a particular meadow.

To alleviate the impact of trespassing livestock, an approximately 1.5 mile, 4-strand, twisted wire fence was constructed along the park boundary north of Hodgdon Meadow in 1966. Another 0.5 mile of boundary fencing was erected west of Highway 41, near the South Entrance, in 1971. These fences have since deteriorated due to lack of maintenance. The effects of these fences on migrating wildlife has not been assayed.

Deteriorated conditions in grazed meadows have been documented: by Sumner and Leonard (1947) in their "mountain meadows" report; by former Park Forester Ernst (1949) in his "grazing situation" survey; by Park Naturalist Sharsmith (1961) in his "comparative meadow ecology" study; and by Park Resources Management Assistant Chief

Ranger Briggs (1964-65) in his report on "backcountry conditions and resources." Some of this research also provides pertinent information and source material for development and implementation of an action program that can guide the restoration and management of grazed meadows and minimize the human influence.

3. ALTERNATIVE ACTIONS AND THEIR PROBABLE IMPACTS:

A. No Action: Under a no action alternative recreational and management stock would continue to graze some backcountry meadows. The current permit system would regulate stock usage. All areas now closed to grazing would remain closed.

Benefits of this alternative are reduced costs for resources management and some artificial meadow maintenance.

Unavoidable impacts would continue to occur; i.e. the normal equine eliminative process and the use of grain and pelletized feed would introduce exotic grasses and forbs to susceptible meadows. Stock overconcentration in popular holding areas would cause ecological transformation in those meadows. Areas closed to grazing due to past abuse may have recovered sufficiently to permit grazing again but would remain closed because of lack of information. If the closed areas were reopened some overgrazed areas might receive less use and recover. In all grazed meadows conditions would depart more from the natural and the meadows might be irreversibly altered.

A no action alternative would violate a federal mandate that requires preservation of native ecosystem and the processes that perpetuate them.

B. Subjectively Refine Stock Grazing Regulations: Under this alternative, grazing regulations would be refined based on observations from qualified Park personnel and not on analysis of ecological data. Additional regulations would include: local closures, seasonal use limits, prohibition of looseherding except under specific conditions, confinement of stock travel to specific trails and meadows, and use of grain and/or pelletized feed in lieu of grazing in specific locations. Invading trees would not be selectively removed.

Enforcement of additional regulations, selective boundary fencing and realignment of drift fencing would better regulate and reduce grazing impacts on some meadows. Hikers wishing to avoid stock could be informed of stock use trails and grazing meadows.

The resetting of stock-use capacities to reflect seasonal variations might decrease the variety of potential trips and the enjoyment of the Park for some stock users. The provisions for drift fences and other facilities for the separation of hiker-rider use would provide more conveniences for stock users, as well as hikers, but such facilities might be offensive to some wilderness users. Recovery of abused meadows, especially those at higher elevations, would be uncertain. Ecologic impacts could continue to accumulate undetected and cause the meadows to be irreversibly damaged. Many meadows would succeed to forests at an accelerated rate.

C. Stop all Stock Grazing of Park Meadows: The thrust of this alternative is to reintroduce those natural mechanisms which control meadow ecology and succession by removing the impacting force of grazing. Management actions which simulate natural processes (such as prescribed burning) would be used as necessary. Man-induced lodgepole pine invasion would be allowed to "correct" itself to the extent possible; however, in meadows where natural fires are not permitted to burn, and where the original watertable has irreversibly altered, prescribed fire would be used to slow this invasion. Improperly designed and constructed trails that dissect meadows must also be repaired to achieve this objective.

The vegetative recovery of grazed meadows will be impossible until the original stream gradient and therefore soil and moisture conditions have been restored. Properly constructed trails are a requirement for restoration of the original stream gradient. Fire's presence in grazed meadows would return nutrients to the soil, increasing plant growth, and kill small trees invading such areas. Where trees are killed, decreased evapotranspiration would result in a higher water table. Since meadows are a seral stage dependent on wet conditions, these factors would tend to preserve their size.

Stock represents only one component of total backcountry use resulting in environmental impact; removal of stock would not insure recovery of impacted meadows. Stock has played and continues to play a critical backcountry management role. The alternative to stock for backcountry management operations would be the intrusion of helicopters in the wilderness. To allow stock but prohibit grazing would increase Park costs and impact due to the need for more animals to carry the extra feed and cause the introduction of more exotic plant seed to sensitive meadows.

D. Develop and Implement a Meadow Restoration and Stock Management Program Based on Source Material and Data Collection: Under this alternative Resources Management would use available source material and conduct meadow impact assessments to develop and implement an action program that would guide grazing and meadow management and minimize human influence. Abused meadows would be restored by check dam installation, trail reconstruction, and/or other corrective measures necessary to stabilize soils and restore the natural stream gradient. Natural and prescribed fire would curtail forest encroachment and in some meadows invading trees might be manually removed. Boundary fencing would be erected if research determines that fences do not adversely affect wildlife movement. Improperly placed drift fences would be removed.

A benefit of this alternative would be meadow resource restoration and perpetuation. Inventories and ecological data collection for each meadow would provide directives for meadow grazing management and permit adequate evaluation of management actions.

A negative impact would be increased Park operating costs. The continued presence of stock would cause unnatural species shifts in grazed areas and increase the potential for exotic plant establishment in some areas.

E. Research: Research would define the pristine meadow condition, providing a target for restorative and management actions. Research would determine the significant effects of grazing on meadow species density and composition and then develop condition standards based upon meadow classification. A Park vegetation survey would describe meadow types which would aid grazing management decisions. This research would increase Park operation costs but would allow managers to objectively evaluate grazing impacts and define management actions required for individual meadows.

4. RECOMMENDED COURSE OF ACTION:

The recommended alternative is a combination of alternatives B, D, and E. Research (E) would provide target information and a vegetation baseline; data collection (D) would provide management directives and source material for evaluation of management actions; and refined use regulations (B) would effectively implement this revised management program. Alternatives A and C are rejected for reasons given in their respective sections.

Meadow resource management would be guided by ecological principles. Grazing-day allotments, based on data collection, would be developed and grazing effects monitored. Proper resource utilization might require both the removal of several drift fences that overconcentrate stock, and the maintenance and/or relocation of other drift fences. Four and one half miles of Park boundary fencing might be constructed in livestock trespass areas following a wildlife impact assessment. Backpackers desiring to avoid stock would be directed to infrequent stock use areas.

5. FUNDING:

A. Recurrent Funds Available in Park Base...............$ None

B. O.N.P.S. Funds Requested............................$15,600.00

NATURAL RESOURCES PROJECT STATEMENT

1. YOSE-N8-EXOTIC PLANT CONTROL

2. STATEMENT OF PROBLEM:

Many exotic plants have become established in Yosemite National Park since the 18th century. Three of these are the most immediate problems; bull thistle (*Cirsium vulgare*), mullein (*Verbascum thapsus*), and Klamath weed (*Hypericum perforatum*) have been identified for at least 30 years as noxious exotic pests. National Park Service responsibilities for control of noxious exotic plants is delineated in NPS Management Policies (1978) by Executive Order 11987. Since Service policy dictates the removal of exotics, information concerning distribution, reproduction, and response to eradication programs for all introduced species must be gathered.

Some exotic plants brought by European explorers and settlers were already established in Yosemite before settlers arrived in 1851. These non-indigenous taxa were transported by wandering native Americans and through natural dissemination by wind and animals. The early settlers in various areas of the Park planted exotic plants for aesthetic purposes and self-sufficiency. They also brought in domesticated animals and adventitious plants. Exotics have flourished most easily near developments where man has created disturbances and has introduced seeds.

> Plowing and heavy grazing broke up or weakened the cover of native plants, creating space readily occupied by the well-adapted introductions, many of which were brought in with the hay, grain and seed imported for feed and cultivation. Seeds were widely disseminated over the Valley floor by grazing animals and by man, and disturbed areas were often deliberately seeded with plants foreign to the Valley. Out of 470 known species of plants on the Valley floor and lower portions of the talus slopes, 18 percent are non-indigenous.
>
> Gibbens & Heady 1964

Exotic plants are most common at lower elevations in the Park, such as Yosemite Valley, where human intrusion and disturbance has been most pronounced. Alpine areas still have a virtually pristine vegetative cover. Most exotic plants in Yosemite are annuals or biennials which are adapted to the summer drought regime typical of the lower elevations of the Sierra Nevada. Many of these are pioneer species which seed prolifically and once established can become dominant over native species.

Many of the 85, and possibly more now, non-indigenous Valley plants have the potential of spreading. Many introduced taxa have invaded the meadows--outcompeting the native species. These plants are so naturalized that it is doubtful they can ever be eradicated. Some exotics, however, are amenable to control. All surviving exotic plants degrade the natural integrity of Park ecosystems and constitute an undesirable alteration of the natural scene.

Despite past hand-eradication and chemical-spraying programs, in the last four years thistle and mullein have proliferated rapidly in Yosemite Valley, becoming particularly well established in the meadows. The presence of thistle, mullein, and Klamath weed in the Valley has prevented prescribed burns critical to native vegetation. These exotic plants quickly establish themselves on recently burned areas, compounding the problem. Without some sort of treatment they may continue to spread and may cover a significant portion of the meadow environment with highly detrimental effects to the native flora and the natural historic scene.

At present, thistle and mullein are difficult and costly to control. Mullein is a fairly hardy plant resistant to many of the biological control techniques. The dense pubescence on the leaves inhibits entry of many plant pathogens and also deters spraying. Another problem is the presence of native thistles in Yosemite; a technique that would wipe out the introduced species might also affect the native varieties. No known rust or fungus will selectively attack mullein or bull thistles. The Park's only solution is hand-eradication (which has proven ineffective) or some sort of biological control.

Klamath weed is even more destructive than thistle and mullein to the natural environment; it is a perennial that reproduces both vegetatively and by seed. Klamath weed at one time infested over two million acres of northern California rangeland. In 1945, the United States Department of Agriculture introduced the European beetle *Chyrsolina quadrigemina* in what was the first attempt at biological control of weeds in the United States. Klamath weed was discovered in Yosemite in the mid 1940's and successfully treated by *Chrysolina* beetles in 1951. The apparent demise of the beetles in recent years has resulted in rapid invasion of roadsides and meadows by the weed.

The exotic plant problem is immediate and will become compounded with time. Without treatment this problem will result in serious deleterious impacts on the natural vegetative environment, especially in Yosemite Valley where the problem is most severe.

Exotic trees which are incapable of reproducing are currently eliminated only by natural death. Annually from 1963 to 1972, approximately 50,000 exotic plants such as mullein, thistle, cocklebur, and sunflower were removed by digging and pulling individual plants from about 700 acres of meadows and road edges. In 1980, YCC and CCC groups hand-eradicated 1,500 mullein and thistles.

Since the discovery of Klamath weed in the mid 1940's several eradication programs have been implemented. In 1946, hand-eradication was attempted in Yosemite Valley. Funding was not available to continue the work in 1947. In 1948, chemical spraying with 2,4D was tried in Yosemite Valley. The 2,4D was effective in controlling those concentrations that were sprayed but other unknown concentrations were free to spread and to re-seed previously controlled areas.

In 1951, 9,800 Chrysolina beetles were released at six locations within Yosemite. The Chrysolina beetle feeds specifically on Klamath weed. Within ten years the beetles had virtually eradicated the weed in Yosemite. The Klamath weed has again become established in the Park. Three affected sites have been identified: Ahwahnee Meadow, East Buttress Meadow, and an area along the Big Oak Flat Road from Yosemite Valley to Crane Flat.

In May and June 1981, 15,000 Chrysolina beetles were released at five affected locations to biologically control Klamath weed. This biological control program is being jointly carried out by the California Department of Food and Agriculture and Park staff. A root-crown beetle and a gall midge are also available for biological control of Klamath weed, and their introduction is being considered by management should supplemental actions become necessary.

3. ALTERNATIVE ACTIONS AND THEIR PROBABLE IMPACTS:

A. No Action: Under this alternative plants would be restricted only by natural death, habitat requirements, and competition with native plants.

This alternative will result in a continuous and progressive alteration of the natural vegetative scene. Exotics will continue to proliferate or escape cultivation, adding their superficial beauty to a land historically breathtaking in its natural scenic grandeur. Exotic plants will continue to usurp ecological niches and the habitats of native species. Some native lowland meadow plants may be virtually extirpated. In addition, the prescribed burning program will be delayed or suspended in critical areas, such as Yosemite Valley and the Mariposa Grove, since many of the exotics are pioneer species and are stimulated by disturbances such as fire. The prescribed burning program is a critical element in the management plan to restore natural processes and reestablish a more natural vegetative cover in the Park.

B. Remove all Exotic Plants: Under this alternative all nonnative plants, including ornamentals and non-reproducing species, would be removed from the Park. A program of this magnitude would be expensive, labor intensive, and would probably have a further detrimental effect on native species. It is also doubtful that such a program could be successful. Many species of exotic grasses and herbs have become so well established in lowland meadows and certain other areas that they have become the dominant vegetative cover. To remove them would require denuding areas and probably using chemical herbicides which would create habitat for other pioneer exotic plants. Biological control would be impossible for such a diverse group of plants, most of which are annuals. These annuals produce large reservoirs of seed which would remain in the soil for many years and would exacerbate the problem of complete eradication.

C. Remove all Noxious Exotic Plants: Non-native grasses would be left in meadows since they are now the dominant vegetative cover. Other widespread non-native plants such as Erodium spp. would be tolerated since their extirpation is virtually impossible. Ornamentals and non-reproducing woody exotics would be left since in many cases they exist close to developments where they are used for landscaping. Noxious exotics such as Klamath weed, bull thistle, and mullein would be removed using biological control where feasible, manual control as a second alternative, and chemical control as a last resort.

This strategy would result in an improvement in meadow vegetative cover particularly in Yosemite Valley where noxious exotics present their greatest threat. Woody exotics would remain as an unnatural visual element, especially in Yosemite Valley. In some cases they would continue to provide aesthetic or historic benefits to the natural and cultural environment. Exotic fruit trees would continue to provide unnatural food sources for Park animals and would increase the incidence of unnatural human-bear interaction and conflict. Non-native grasses, herbs, and forbs which are not judged noxious would continue to maintain their current population or would slowly increase. The elimination of noxious exotics from meadows will allow prescribed burning schedules to be met. Systematic prescribed burning will provide increased benefits to the natural and historic vegetative scene by reducing tree invasion and restoring more natural vegetative succession.

D. Remove all Exotic Plants which can be Extirpated without Adverse Effects to Native Species, Except those Protected by or Nominated for National Landmark Status or of Special Cultural Interest: Under this strategy noxious exotics would receive the highest priority for removal. Generally all exotic trees and shrubs would be removed unless protected by, or nominated for, National Landmark status. However, those species protected by National Landmark status and reproducing with a potential for population spread would be removed within the requirements of the Historic Preservation Act of 1966 with amendments. Another exception would be exotics of special interest such as one sugar maple (Acer saccharum) and a number of giant sequoias (Sequoiadendron giganteum) planted and growing out of habitat in Yosemite Valley. Since both species are unable to reproduce in the Valley, they would be left as they are; however, if they became a problem, they would be removed.

Biological, manual, and chemical control methods would be employed where feasible and where the natural environment could be protected.

Under this alternative the vegetative cover of the Park would gradually be returned to a more natural state. Prescribed burning could once again be utilized as a vegetative management tool in Yosemite Valley meadows.

E. Research: Research would be undertaken to assess the effects of exotic plant invasion on native plants and their habitats. Studies designed to develop or discover biological control agents for noxious exotics such as bull thistle and mullein are needed to provide effective management techniques. Without research, management may have to rely on costly, labor intensive, and only partially effective hand removal for many exotics. In extreme situations management may have to resort to chemical control, but this is not preferred because of its deleterious effects on the natural ecosystem. Research may be needed to define and assess those effects should chemical control become necessary.

A vegetation survey and a gradient model of the park's vegetation is needed to identify the structure and composition of the park's natural plant communities, and to make inferences about the geographic locations of exotic species within the park. Field surveys would then confirm the presence or absence of a particular exotic species at these locations. Without such information, it is very difficult to assess the overall impact of exotic plants on park ecosystems.

F. Prevent the Introduction of Additional New Exotic Plants: Seed dispersal is difficult to control, however precautions can be taken in some situations in which seeds can be introduced. Plants or soil brought into the Park as part of revegetation or other projects would be sterilized. Also, all plant material for landscaping or revegetation would be collected within the Park and restricted exclusively to native species and varieties. Native genetic purity would be preserved to the maximum extent possible to prevent loss or alteration of gene pools and unnatural hybridization. Exotics which are closely related to native species may have the potential to have greater deleterious effects on natural populations and their habitat than exotics which are totally unrelated and require cultivation for existence.

4. RECOMMENDED COURSE OF ACTION:

The first two alternatives are rejected for either allowing continued invasion of exotics or being impractical and of doubtful effectiveness. Alternative B also would probably produce unacceptable impacts on the natural environment. Alternative C is rejected because it fails to achieve the management objective of restoring the natural scene in the Park to the maximum extent possible. The recommended course of action is a combination of alternatives D, E, and F.

In May and June 1981, 15,000 *Chrysolina quadrigemina* beetles were released on five sites infested with Klamath weed. This biological control program would be continued until the beetles are well established and have eliminated all known infestations of Klamath weed. An environmental assessment covering this project has been approved by the Director, Western Region, and is available for review in the

Park. Biological control agents are needed for bull thistle and mullein. Since there are no known host-specific biological control agents, research must be undertaken to attempt to develop one for each species. Current limited manual control methods must be continued until such time as biological controls are developed.

The effectiveness of biological, manual, or chemical control measures on these three noxious exotics would be monitored systematically. Surveys would be initiated to determine the distribution of noxious and other exotics in the Park and to detect the introduction of any new exotic plants. The effect of exotic plant invasion on the habitat of rare, threatened or endangered plants also needs study.

Current precautions against the accidental or deliberate introduction of new exotics would be continued.

5. FUNDING:

A. Recurrent Funding Available in Park Base............$ None

B. O.N.P.S. Funds Requested...........................$24,600.00

NATURAL RESOURCES PROJECT STATEMENT

1. YOSE-N9-HAZARD TREE REMOVAL

2. STATEMENT OF PROBLEM:

A. Current Condition: In 1970, one person was killed and another seriously injured by a tree falling on a concession facility. Four years later five cabins, occupied at the time by seven people, were destroyed by a falling tree. Fortunately, no one was seriously injured. Recently, between March 1980 and May 1981, fifteen hazardous trees and four limbs fell in Yosemite Valley alone, damaging buildings, tents, utility lines, vehicles and roads. During the same period two large sequoia trees fell in the Mariposa Grove, seriously damaging the Big Trees Lodge and blocking the road.

During the past several years, park forestry crews have removed approximately 1,100 trees annually with an additional 900 more removed by logging contractors via surplus property disposal procedures. All trees removed were hazardous to people or property, and operations were confined entirely to developed sites or within striking distance of roads. For the same reasons hazardous limbs have been removed annually from another 100 trees. In spite of such efforts more than 20 structurally weak or dead trees and limbs have fallen each year, damaging facilities and personal property and threatening the safety and well-being of visitors and employees alike.

Such trees are weakened or killed by several species of native fungi, forest insects, mistletoe, lightning, wind-throw, wildfire, vandalism, and mechanical injury. More commonly, mortality involves a long-term interaction by a complex of pathogens such as fungi, forest insects, and mistletoe. Other predisposing factors can be mechanical injury to the tree from lightning, wildfire or competition for light and nutrients.

Recently, annosus root rot (Heterobasidion annosum), a native fungus, has been recognized as the most important pathogen of coniferous trees in Yosemite Valley. Throughout wildland portions of this valley it occurs but presents no management problem. However, in developed areas, trees killed or weakened by annosus become serious hazards. Since this fungus can successfully infect injured trees or cut stumps and also spreads by root contact to healthy trees, previous activities and use of developed areas have intensified the problem. Today this organism represents a serious threat to the continued existence of coniferous trees in Yosemite Valley developed areas. Elsewhere in the Park, annosus represents a potential threat but no currently identified problem.

Until recently no practical method for identifying a tree infected by annosus was available. This resulted in a number of hazardous trees remaining undetected until they fell.

Studies conducted since 1971 reveal that most unpredicted coniferous tree failures in Yosemite Valley are attributable to annosus root rot. Therefore, all trees in developed areas exhibiting symptoms of the disease should be removed. There are currently 99 confirmed annosus infection centers identified and mapped by plant pathologists in Yosemite Valley developed areas. Perimeters of these centers are expanding at an estimated rate of two to three feet annually.

Also, about 20 to 30 trees and logs annually fall or are likely to fall into the Yosemite Valley reach of the Merced River each year. Unless removed, such trees form log jams, which threaten the three low bridges spanning the river. Damage to some other facilities is also possible. Log jams and snags also endanger rafters and innertube users on the river. Each year snags cause a number of accidents to floaters and occasionally lives are lost.

B. Past Management Actions: Since the early 1940's, all developed areas throughout the Park have been surveyed annually for hazard trees; hazards were evaluated and trees rated accordingly. Removal priorities were directly related to severity of hazard. Due to their proximity to buildings many trees had to be climbed, rigged and removed in sections. This work was dangerous and costly and resulted in development of a highly skilled and experienced forestry organization.

Attempts to control beetle population have been conducted throughout Park forests since the 1930's. This blanket action is no longer desirable or permitted by Service policy. For the last 14 years, all control actions on beetle infected trees have been confined to developed areas. The rationale for this change is that throughout the Park generally bark beetles are native and important components of forested ecosystems. However, people are concentrated in developed areas. Therefore, trees that die in the latter areas as a result of forest insect attack become hazardous and have to be removed to provide for a proper level of public safety.

Studies of lodgepole needleminer (*Coleotechnites milleri*) biology and ecology have been carried out in the Tuolumne drainage of the Park since before 1949. Attempts to control infestations were carried out through 1963, when management policies foreclosed such efforts except for a few specific circumstances. Research to develop an acceptable system to control the lodgepole needleminer in developed areas only continued through 1980, when that program was terminated.

The presence of annosus root rot and its role as a forest pathogen began to emerge here as early as 1961, but it was not until 1971 that its true importance began to be recognized. At that time a study of the problem was begun which continues to this date. The study, administered by the U.S. Forest Service, was conducted jointly by plant pathologists from the University of

California, Berkeley, and Region 5 of the Forest Service. Identification of infected trees, infection centers, rate of spread and guidelines for the above-ground identification of annosus in incense-cedar (Calocedrus decurrens) and ponderosa pine (Pinus ponderosa) and general recommendations for dealing with the annosus problem in developed areas have resulted from this research.

During the late 1970's, a bark beetle infestation peaked and resulted in tremendous tree mortality throughout the State and the Park and in particular. While no control of these native insects was desired or attempted, the resultant tree kill greatly increased the number of hazard trees that had to be removed. The scope of the work exceeded the resources of the Park. To cope with this problem, forestry crews marked a great number of such trees and they were sold by the General Services Administration (GSA) as surplus government property. The buyer, usually a logging contractor, was required to fall and remove the trees and perform site cleanup to Service specifications.

3. ALTERNATIVE ACTIONS AND THEIR PROBABLE IMPACTS:

A. No Action: Discontinue all hazard tree and limb removal and all removal of logs from the Yosemite Valley reach of the Merced River.

Adverse impacts of this alternative would be the resultant injury and death to people and damage to facilities and personal property from falling trees and limbs. Also hazardous trees and logs would damage bridges and roads and snag and upset people floating on rafts and inner tubes in the Valley reach of the Merced River.

Beneficial impacts would be the lack of disturbance and noise from discontinued removal operations. Dead and dying trees and limbs would be allowed to stand until they fell naturally. Such trees and limbs would provide some additional habitat for animals, especially birds. Fish and other aquatic life would benefit from additional habitat provided by submerged logs and small log-jams.

B. Continue Current Level of Hazardous Tree and Limb Removal: All trees within developed sites and those within striking distance of roads will be surveyed and evaluated annually as to their degree of hazard. Through such an evaluation procedure, hazardous trees and limbs are prioritized for removal.

Currently, between 1,300 and 1,500 trees, dead or dying from a number of natural and man-caused influences or actions, are rated as sufficiently hazardous to require removal each year. Approximately 20 percent of such trees must be climbed, topped and removed in sections to protect adjacent facilities. All stumps must be flushed and slash properly disposed of. Logs are routinely made available to the public for firewood.

One or more large limbs would be removed from approximately 250 trees annually, with cleanup and disposal as described above. All removal operations would be carried out by Park forestry crews.

All known archeological and historic resources will be avoided to the greatest degree possible. However, all trees eventually fall from natural or human causes. Therefore, where proposed work could adversely affect cultural resources, appropriate clearances will be secured and prescribed-mitigating measures employed.

Adverse impacts would be periodic noise and disturbance and the temporary withdrawal of affected facilities from use associated with removal operations. These impacts are mitigated fairly well by working developed sites during periods of low visitation. Another adverse impact would be the loss of habitat by animals requiring dead snags and insect infested trees. The latter is largely mitigated by the relatively small size and dispersed location of areas involved in such activities.

Beneficial impacts would be the increased protection from falling trees and limbs afforded to people and property, including historic structures. Another benefit would accrue from the slowing of the advance of annosus root rot, which thereby extends the life of trees in developed sites. Also, there would be an incidental benefit to the public from hazardous tree logs being made available without cost for firewood purposes.

C. Remove Log-jams from Yosemite Valley Reach of Merced River: Approximately 20 to 30 trees, logs and stumps would be removed each year from this reach of the river to eliminate log-jams which threaten low bridges and recreationists rafting on the river.

Adverse impacts would be some loss of aquatic habitat by removal operations. Also there would be a loss to riparian animals by removal of possible nest sites, perches, and food sources. This action would result in a small adverse impact on the aesthetic resource due to the unnatural removal of logs, stumps, and trees and the short-term disturbance of the operation itself.

Beneficial impacts would be protection of bridges and other facilities, and the protection afforded rafters and inner tube floaters from being snagged and/or overturned in cold, fast flowing waters.

D. Disposal of Hazardous Trees through Surplus Property Sale Procedures: When hazardous trees cannot be disposed of through normal channels described in Alternatives B and E, the merchantable portion would be sold through surplus property procedures. Such sales would be administered by the GSA and all proceeds would be deposited in the General Fund of the U.S. Treasury.

One adverse impact of this alternative might be the mistaken impression by the public that the Park is being managed for resource extraction rather than preservation and resource related recreation as is the case.

Beneficial impacts would be that necessary work that exceeds the financial resources of the park can be carried out, and hazardous tree threats to people and property would be reduced. Also, the General Fund of the U.S. Treasury would benefit from revenues of such sales. Lastly, private industry would benefit from a source of timber on those occasions when hazard tree volumes on hand required disposal through surplus property sales.

E. Increased Level of Hazardous Tree and Limb Removal: Removal of 900 additional trees above those currently treated annually would provide a high level of protection for people and property from tree and limb hazards.

Adverse and beneficial impacts would be proportionately greater than those listed for B above.

F. Reduced Level of Hazardous Tree and Limb Removal: Hazard surveys and evaluations, site cleanup and disposal of wood would be as described in B above, except that no more than 1,000 trees and 100 limbs would be removed.

Adverse impacts would be as listed in B above but proportionately smaller in scope. An additional impact would be the increased damage to facilities and personal property and the additional threat to personal safety that would result.

Beneficial impacts, though smaller in scale, would be those listed for B above.

G. Contract Hazard Tree and Limb Removal Operations: Hazard tree surveys and evaluations and contract administration would be carried out by the Park Forester and his staff. All removal operations would be at the level prescribed in B or E above but carried out under contract with private, licensed, tree service organizations. Site cleanup would be as described in B above; wood disposal also would be as in B above with a contract provision that the value of the resulting merchantable wood available to the contractor would offset part of the Park's cost of the contract service. The contractor would then own the merchantable logs and be free to sell them for profit.

One adverse impact would be the greatly increased cost of hazardous tree removal resulting from a contract operation. Another adverse impact would affect forestry workers, usually permanent employees. The need for such employees would be reduced and places for them in other park operations would have to be found or their employment terminated.

This alternative would benefit tree service organizations and their employees working on hazardous tree removal contracts.

4. RECOMMENDED COURSE OF ACTION:

Alternatives A, F and G, are rejected for reasons stated in the previous section. The recommended actions are a combination of alternatives B, C, D and E, which would provide that level of control necessary to insure that park visitors, employees, concessioners, contractors and other residents and property are adequately protected from accidents involving hazardous trees and limbs in developed areas and roads and by snags and log-jams in the Yosemite Valley reach of the Merced River.

The following is a detailed description of the recommended course of action by category. However, even this level of control cannot insure against tree and limb failures resulting from extremely heavy snow or rainfall with or without high winds.

A. Resources Management Actions:

(1) Hazardous Tree Removal: Annually remove between 2,200 and 2,400 hazardous trees, dead or dying from a number of natural or man-caused influences or actions. Removal operations require skilled personnel and specialized equipment such as aerial platforms and log-loaders. Approximately 20 percent of such trees must be climbed, topped and removed in sections to protect adjacent facilities, a task that exposes even a skilled forestry worker to considerable risk.

(2) Hazardous Limb Removal: Annually, one or more hazardous limbs need to be removed from each of approximately 250 trees. Most such limbs are large and heavy and occur on black oaks (*Quercus kelloggii*). The remainder are found on other oak species and a few coniferous trees.

Removal requires a forestry worker to climb each tree with climbing belt and spurs, rig limbs to be removed, remove them with a chainsaw, and lower or direct their fall to the ground. Finally, resultant scars on trees are treated with tree paint to protect the wounds and enhance the appearance of the tree.

When available, an aerial platform is used by forestry workers to get in and out of such trees. Use of such equipment results in much improved crew efficiency and safety.

(3) Remove Log-jams from Yosemite Valley Reach of Merced River: Approximately 20 to 30 trees, logs and stumps would be removed each year from this reach of the river to eliminate log-jams, which threaten low bridges and recreationists rafting on the river. Trees and logs would be removed during periods of low flow in early spring and

fall. Also trees in imminent danger of falling into the river during the ensuing high water period could be removed.

(4) Disposal of Logs, Limbs and Slash: Site cleanup associated with the above described actions requires cutting trees into transportable lengths and hauling them to park woodyards. Slash is chipped and used locally, piled and burned during winter and spring, hauled to campgrounds for camper fuel and, along roadsides only, lopped and scattered.

Logs and large limbs that can be cut up for firewood are routinely made available without charge to the public in designated woodyards.

However, whenever hazard tree volumes exceed the above-described avenue of disposal, excess material will be disposed of through approved surplus property disposal sales. Under these procedures the Park Forester estimates the volume of merchantable, surplus timber and requests GSA for a surplus property sale. If approved, GSA draws up a contract, with environmental and other specifications provided by the Forester. Invitations to bid are sent to local logging contractors and other interested parties and the contract is awarded to the highest qualified bidder.

Park forestry crews then fall the trees and the successful bidder, now the contractor, is responsible for bucking the trees into logs and hauling them to a sawmill. There the trees are sawn into lumber and the official mill scale volume determined. The contractor's payment is based on mill scale volume and such monies are received by the Park and deposited in the U.S. Treasury. Depending upon the work site, slash disposal and stump flushing can be a responsibility of either the Park or the contractor and is reflected in the amount paid for any contract.

The only benefit to the Park of this mode of disposal is that some work, normally done by the Park, is passed on to the contractor. When hazardous trees are numerous and funding scarse, employment of this procedure is often the only way that such trees can be removed.

(5) Stump Treatment: All stumps are routinely flush-cut at ground level and treated within two hours with Borax (Sodium tetraborate decahydrate). This chemical is the recommended protection agent to prevent infection of freshly cut stumps with annosus spores.

In areas of intense human use, flushed stumps are often ground down to two inches below ground level to reduce their hazard to walkers. Such stumps are treated again with Borax.

(6) Length of Time Actions are Needed: All of the actions described above are recurring and will have to be carried out indefinately.

B. Monitoring Actions:

(1) Hazardous Tree and Limb Surveys: All trees within developed sites and those within striking distance of roads will continue to be surveyed and evaluated annually as to their degree of hazard. Surveys are under the direction of the Park Forester and are carried out by forestry personnel working under the supervision of experienced Forestry Foremen.

The evaluation system is comprised of two basic elements. One relates to the tree itself, i.e., the chance of imminent failure rated on a scale of one through three. An additional point is added if a tree is dead or exhibits a severe lean. The other element relates to the target (i.e. facility, personal property or person) and the type or extensiveness of damage and/or injury which would probably occur if the tree failed. Values are similarly rated on a scale of one through three, with a tree expected to do most damage or cause injury upon failure receiving a rating of three. The value for both elements is added for each tree and the resultant value is equivalent to its priority for removal. The highest priority is seven and indicates a highly defective leaning or dead tree which will cause extensive damage and/or possible injury upon failure.

Guidelines, recently developed by forest pathologists, for the detection of annosus infection in incense-cedar and pines by crown characteristics are now used in hazard evaluations.

Records of hazardous tree and limb surveys will be maintained in the Park Resources Management Office.

5. FUNDING:

A. Recurrent Funding Available in Park Base...........$222,900.00

B. O.N.P.S. Funds Requested.........(1st year)........$153,000.00
(recurring).......$ 63,900.00

NATURAL RESOURCES PROJECT STATEMENT

1. YOSE-N10-PLANT PROPAGATION AND REVEGETATION

2. STATEMENT OF ISSUE OR PROBLEM:

A. Current Conditions: Due to the concentrated and longterm human use and influence that occurs in developed sites, young trees and shrubs rarely become established naturally; and of those that do, fewer still attain maturity. At the same time mature trees on such sites continue to die or become structurally weak and have to be removed to protect human life and property. Among the few shrubs that occur in these sites, some die almost every year. The end result is that woody vegetation in such sites is becoming progressively less dense, and openings in the forest canopy are occurring more frequently. The shade and screening that made such sites desirable for camping or lodging, and the vegetation that serves to landscape these developments is gradually being removed without adequate replacement.

At present the problem is acute only in Yosemite Valley, Glacier Point and Wawona areas. The problem is also imminent at Tuolumne Meadows and Tenaya Lake developed areas, where nearby lodgepole needleminer (Coleotechnites milleri) infestations threaten to cause tremendous tree mortality in developed areas of inadequate tree reproduction.

Further, there is a long neglected need to revegetate abandoned developed sites and construction scars. Examples are sites of former buildings and roads, old garbage and barrow pits and the newly designed Valley Mall, which replaces a large parking area. Frequently such sites have no topsoil and are very resistant to natural revegetation. The following is a list of the sites most in need of revegetation:

Curry Garbage Pit	approximately	3	acres
Valley Mall	"	10	"
Seven annosus root rot openings in Valley campgrounds	"	5	"
Glacier Point Hotel scar and parking area	"	3	"
El Portal Administrative Area	"	15	"
Wawona Campground	"	3	"

Old Tioga Pass Road and			
Gaylor Pit	"	50	"
Tuolumne Meadows Campground	"	20	"
Tenaya Lake Campground	"	1	"

B. Past Actions: In 1979 one acre of Lower River Campground, denuded by annosus root rot (*Heterobasidion annosum*), was revegetated with rot resistant black oaks (*Quercus kelloggii*) and mountain dogwood (*Cornus nuttallii*). Approximately one acre of the Valley Mall has been revegetated with a number of native trees, shrubs and herbaceous plants during 1980. Similarly, a small amount of native vegetation has been planted in the Glacier Point Hotel scar.

In 1979 the Park acquired a surplus Vermeer Tree Planter and a five-ton truck to carry it. This equipment has already proved to be invaluable for transplanting native wildlings.

3. ALTERNATIVES

A. No Action: No revegetation of denuded, developed areas and construction sites would be undertaken. This alternative would rely entirely on natural revegetation which is extremely slow in such sites.

Adverse impacts would be that such sites would remain denuded for relatively long periods of time, and besides being aesthetically unpleasing, would also lack normal shade and screening. Further, such sites would provide extremely poor habitat for native animals and plants and be subject to continued accelerated erosion.

The only beneficial impacts identified would be the economies resulting from no action and a lack of minor work noise and disruption.

B. Plant Propagation and Revegetation at Minimal Level: Seeds, seedlings or cuttings would be collected in the park from a number of native trees and shrubs and propagated in nurseries in the El Portal Administrative Site or near the park. Wildlings (native, young, trees and shrubs) would be excavated with the Vermeer Treeplanter and transplanted and maintained in denuded developed areas. All plant material would be native to the park.

Under this alternative work described above would be carried out only in the most visible developed sites.

Adverse impacts would consist of very minor soil disturbance from the collection, propagation and transplantation of native seeds, cuttings and wildlings. Such actions would also result in some spread of various other native and non-native plants, invertebrates and possibly plant diseases. However, when compared with the effects of road and utilities maintenance and construction activities that have been carried out here for decades, the above-listed efects would be minimal. Also, the removal of native seeds, cuttings and wildlings would constitute very minor, short-term, impacts in local habitats.

Beneficial impacts would be revegetation of denuded sites, with improved habitat for native animals and plants, reduced erosion and improved aesthetics, shade and screening.

C. Plant Propagation and Revegetation of All Developed Areas: Annually collect native plant material in the park and propagate same in nurseries. Transplant nursery stock and wildlings into denuded sites in developed areas and disturbed construction sites.

All such disturbed sites would be prioritized for revegetation and several highest priority sites planted each year. Work would be carried out as in Alternative B but increased in scope.

Adverse and beneficial impacts would be the same as B but proportionately larger.

4. RECOMMENDED COURSE OF ACTION

A. Resource Management Actions:

(1) Collection of Plant Material: Native seeds, cuttings and plants would be collected each year. Some such plant material would be propagated in a park nursery while others might at times be raised in commercial nurseries outside the park. However, only endemic plant material collected within the park would be used to insure that no genetic contamination would occur.

(2) Revegetation of Denuded Areas: All denuded sites in developed areas would be prioritized and scheduled for revegetation work so that a reasonable amount could be accomplished each year. Besides transplantation, revegetation work might include soil scarification, addition of topsoil, sand or mulch, application of fertilizer or growth hormones, pruning, watering, fencing or otherwise protecting plants. Some or all of these activities would be carried out until plants became well established, then discontinued. An exception to the latter might be the Valley Mall plantations, where continuous impacts from heavy public use might require continued irrigation.

Archeological and historic resource clearances would be obtained for all excavation involved in obtaining plant material for revegetation of denuded sites. In addition all plant material secured by excavation would be obtained outside of known cultural resource sites.

B. Monitoring Actions:

(1) All planting would be monitored as frequently as required to determine their status and needs until they became well established. After that they would be monitored a minimum of five times over the ensuing ten years to determine relative growth rates and survival of various species and the efficacy of various horticultural methods.

5. FUNDING

A. Recurrent Funding Available in Park Base............$ None

B. O.N.P.S. Funds Requested............................$19,000.00

1. YOSE-N15-BLACK BEAR MANAGEMENT

2. STATEMENT OF PROBLEM:

A. Current Conditions: The black bear (*Ursus americanus*) population of Yosemite National Park has been severely impacted by the presence of humans during the past eighty years. Contributing factors were open pit dumps, accessibility of visitor's food and refuse, intentional feeding, and non-aversive encounters with visitors. These impacts produced alterations in abundance, density, reproduction rates, distribution, behavior, and physical characteristics, resulting in population characteristics not consistent with a naturally regulating population. National Park Service management policies dictate that all parks will strive to maintain the natural abundance, behavior, diversity, and ecological integrity of native animals in natural portions of parks as part of the park ecosystem. In order to mitigate the effects of human presence and restore the natural integrity of the endemic black bear population the Human/Bear Management Program was developed and initiated. Although the number of bears involved and the level of incidents has greatly decreased, human/bear conflicts persist at an unacceptable level and require the greatest funding and humanpower of any wildlife program in the Park. A description of the current Human/Bear Program follows.

Authorities, responsibilities and program outlines are delineated in the 1981 Human/Bear Management Plan. The Wildlife Biologists are to ensure that all divisions and the park concessioner fulfill their designated responsibilities.

Goals: The objectives of the management plan are consonant with the Management Policies of the National Park Service and are as follows:

(1) To restore and maintain the natural integrity, distribution, abundance and behavior of the endemic black bear population.

(2) To provide for the safety of Park visitors by planning the development and use of the Park so as to prevent conflicts and unpleasant or dangerous incidents with bears.

(3) To provide opportunities for visitors to understand, observe, and appreciate the black bear in its natural habitat with a minimum of interference by humans.

The Management Plan consists of five critical elements necessary to achieve our management objectives:

(1) Public Education and Information. Information is disseminated to the general public through a variety of tech-

niques. Signs warning park visitors of their entrance into bear habitat are posted at all park campground entrances, trailheads, and roadside parking lots. Frontcountry overnight visitors and visitors obtaining backcountry use permits receive printed brochures that specifically address the human/bear problem and necessary visitor behavior to prevent human/bear encounters. Every issue of the Yosemite Guide contains bear information. Interpretive programs concentrating only on the human/bear problem are presented weekly at campground programs and the human/bear problem is briefly discussed at the onset of all interpretive presentations. In addition, all visitor centers contain a bear information display.

(2) Removal of Artificial Food Sources. All refuse containers are bear-proofed with the exception of open dumpsters situated in residential and maintenance areas for the disposal of non-organic materials.

Food lockers have been installed in two frontcountry campgrounds and experimentally in one managed backcountry area. A total of 35 bear-proof food cables have been installed in 11 backcountry areas of concentrated human use. Development and field testing of a portable bear-proof food container for backcountry visitors is continuing.

(3) Enforcement of Food Storage Regulation. Yosemite National Park established a regulation requiring that all food be properly stored at all times and refuse properly disposed. The regulation is enforced with the lowest level of action necessary to correct the situation. Verbal warnings are the basic enforcement procedure and citations are rarely given.

(4) Control of Conditioned Bears. If an animal frequents an area of human concentration, or is responsible for property damage or personal injury to park visitors, a capture is attempted. Capture attempts are conducted by personnel specifically trained in chemical restraint of black bears. Once the animal is immobilized, biological data is collected and the animal is tagged with an ear tag and streamer and lip tattooed if not previously marked. Upon completion of data collection and tagging, a decision is made whether to translocate or destroy the animal. This decision is based upon a review of the animal's behavior and capture and translocation history.

(5) Monitoring and Research. In order to monitor the effectiveness of the human/bear management plan several indicators are recorded. The foremost being the number of incidents when property damage occurs as a result of bear(s) activity. Data recorded are dollar damage, date,

time, location, method of food storage and bear identification if available. Personal injuries are recorded as well.

Biological data collected monitors shifts in the sex/age structure of the population and the physical condition of captured animals.

Backcountry food storage techniques are evaluated to determine visitor efforts and attitudes. Data collected from the evaluation are used to revise the information brochure and recommended food storage techniques.

During the fall or winter an annual human/bear management program critique is conducted and is the basis for revisions in the Human/Bear Management Plan.

B. Past Actions: Yosemite Valley became a commercialized area in the early 1860's with the operation of hotels resulting in sporadic human/bear encounters. By the 1910's automobile traffic was heavy and human/bear encounters had increased. During the 1920's, bear shows were regularly sheduled at open pit dumps with platforms, troughs, and floodlights. This accelerated the increase of human/bear encounters and bears began breaking into vehicles and buildings during the day. By the 1930's management consisted of feeding stations at the west end of the Valley to lure bears away from the developed east end, as well as trapping and relocating of troublesome animals. Bear dogs and shotguns were used to discourage bears from frequenting the developed areas. Bears became troublesome in Tuolumne Meadows in 1931, previously an area of few bear observations.

In 1933, George Wright, NPS Chief of the Wildlife Division, recommended the following to Superintendent Col. Thompson: a) regulate bear population by limiting artificial food to a minimum and destroying surplus animals; b) enforce feeding regulations; c) patrol developed areas; d) provide food-safes and bear-proof refuse containers; and e) possibly even fence camp areas.

Between 1933 and 1938, 45 bears were sent to San Bernadino Mts to be released by California Department of Fish and Game personnel. Reported personal injuries reached a high in 1937 when 55 people were treated at Le Conte Memorial Hospital. New regulations prohibiting feeding, touching, teasing, or molesting bears were instituted in 1938 in an attempt to reduce injuries. From 1940 to 1944 further attempts to reduce human/bear encounters where initiated when the bear shows were discontinued. Feeding on the Valley Rim and at Gin Flat continued in an attempt to establish bears outside of the Valley. From 1937 through 1953 an average of 10 bears a year were either destroyed or sent to other areas. Between 1960 and 1973 reported management kills averaged 15 per year.

The first bear-proofing occurred in 1963 when all Valley 32 gallon garbage cans were bear-proofed and the Curry Dump was closed. Tuolumne and White Wolf, the last remaining dumps--were closed in 1971.

In 1974 the Human/Bear Management Plan was implemented to establish a coordinated and centralized management program and a five year black bear ecology research project began. By 1975 all dumpsters in the Park were bear-proofed by a design conceived in Yosemite. Also in that year, reported bear incidents and property damage were at an all time-high with 975 incidents resulting in $113,000 of damage. Intensive management action took place in 1976 with 131 translocations performed and 15 bears destroyed. Food storage lockers were installed in 1977 at White Wolf campground, an area of historic human/bear problems. Within one year, White Wolf campground had been eliminated as a problem area. In 1977, the backcountry human/bear problem reached a level of approximately 300 reported incidents and has continued to fluctuate around that level. A research project to study black bear behavior and human-bear relationships, including an evaluation of aversive conditioning techniques was conducted during 1978 and 1979. The lowest number of frontcountry incidents and management actions occurred in 1980. Only 75 incidents were reported and 13 animals captured with 10 translocated. None were destroyed. The Human/Bear Management Plan has been revised on an annual basis to insure that it accurately reflects the program.

3. ALTERNATIVE ACTIONS AND THEIR PROBABLE IMPACTS:

A. No Action: The no action alternative would not eliminate artificial food sources or provide for management of conditioned bears. Food storage regulation would not be enforced and educational information would not be disseminated. Human/bear encounters would not be monitored nor food storage evaluations continued.

Adverse impacts upon the Park visitor would be: a) increased human/bear encounters, b) increased bear incidents and property damage, c) increased personal injuries, and d) increased potential for a human fatality.

Adverse environmental impacts upon the black bear population due to the continued presence of artificial food sources would be the unnatural alteration of the following: a) behavior, b) home range distribution and configuration, c) habitat use patterns, d) movement patterns, e) age/sex ratios, f) reproduction, g) physical condition, h) food habits, and i) density.

B. Continue existing Human/Bear Management Program: Continue existing human/bear program as described in statement of problem.

Benefits of this alternative are the progress towards restoring the natural integrity of the black bear population, and a reduction in human/bear encounters and property damage.

Adverse environmental impacts of this alternative are addressed in the National Park Service Environmental Assessment--Human/Bear Management Program prepared May 1975.

C. Installation of Food Lockers in Frontcountry Campgrounds: Install one bear-proof food locker in each frontcountry campsite. Each locker (48 x 18 x 18 inches) would be mounted on a concrete slab (48 x 18 x 6 inches).

The presence of these food lockers represent a convient food storage method and would virtually eliminate the availability of artificial food sources to bears and other wildlife.

No adverse environmental impacts would exist because the lockers would be located in existing developed campsites.

D. Accelerated Development of Portable Bear-proof Food Containers and Distribution System: Development of a light-weight bear-proof food container and a distribution system would result in a fool proof method for food storage in the backcountry. Individual containers would eliminate the need for food storage cables, reduce food theft (an occasional occurrance at cables and lockers), bear-proof visitor backpacks during trailside stops, and allow easy access to food by visitors. Due to the convience and ease of operation, a high level of use is expected resulting in the critical elimination of available human food sources and corresponding reduction in human/bear encounters.

No adverse environmental impact.

E. On-Site Release of Captured Conditioned Bears: Upon recovery from the immobilization effects the bear would be released in the capture area. The bear would then return to the area where the potential for additional behavior modifications exists, increasing the probability of incidents occurring, and possibility of injury to Park visitors.

Adverse environmental impacts would be that behaviorly modified bears would become increasingly skilled in obtaining human foods and would lose their fear of humans. As behavior modification continues and incidents increase more bears would have to be destroyed.

F. Destruction of All Conditioned Bears: Any bear that frequents areas of human concentration in either the frontcountry or backcountry, known to be involved in incidents or responsible for the injury of a park visitor would be destroyed.

This alternative would result in a temporary reduction of human/ bear incidents; however it only addresses the symptom not the problem source.

Environmental impacts would be significant under this alternative due to the number of bears that would be killed. A severe bear population reduction would produce a population with unnatural characteristics.

G. Research: Despite the completion of two research projects concerned with black bears in Yosemite additional studies are needed. They are as follow: 1) Analysis of vegetation communities that can provide a quantitative description, map and identification key of vegetation communities and habitat types on lands within and adjacent to the Park where park-tagged bears have been observed. This baseline data would improve managements' understanding of habitat use and movements, effects of translocations and black bear distribution and densities of the endemic black bear population. 2) A human/ bear encounter study would research the effects of different levels and types of human contact on black bear behavior. Identification of behavior modification that takes place during the transition of a wild bear to a conditioned animal may reveal necessary changes in backcountry management and visitor use patterns. 3) A population dynamics study to determine the effects of management actions and reduction/elimination of human food source upon population status and trends. One three year study would be needed upon complete implementation of all human/bear managment program elements.

Study number 1 involves no environmental impacts. Environmental impacts of studies 2 and 3 would include moderate levels of stress during capture attempts and collection of biological data. Captures would be performed by highly trained and experienced biologists.

4. RECOMMENDED COURSE OF ACTION:

A. Resources Management Actions:

1. Continuation of existing Human/Bear Management Program.

2. Installation of bear-proof food storage lockers in front-country campsites.

3. Acceleration of development of portable bear-proof food container and distribution system.

B. Monitoring Actions:

1. All necessary monitoring actions are provided for under existing Human/Bear Management Program.

C. Research Actions:

1. Initiation of the proposed vegetation study within five years.

2. The proposed studies: Effects of varying levels of human presence/contact on black bear behavior; and a Population dynamics study should begin after food lockers have been installed in frontcountry campgrounds and portable food containers have been developed and distributed to back-country users.

5. FUNDING:

A. Recurrent Funds Available in Park Base..............$25,300.00

B. O.N.P.S. Funds Requested...........................$129,500.00 (nonrecurring)

NATURAL RESOURCES PROJECT STATEMENT

1. YOSE-N17-DEER HERD AND RANGE MONITORING

2. STATEMENT OF PROBLEM:

A. Current Conditions: Yosemite National Park provides spring, summer and fall habitat for deer in the Yosemite and Tuolumne Deer Herds. Since virtually no deer winter range occurs in the Park, these deer are largely influenced by the affects of hunting and land management practices outside Yosemite. The California Department of Fish and Game strives to provide high quality recreational hunting of deer by maintaining 20 - 30 bucks per 100 does in most populations, and by harvesting surplus animals, thereby stabilizing the herd at some optimum level. Natural deer populations typically had buck:doe ratios of 80:100. Natural populations were also characterized by being cyclic in nature, as opposed to stable, with herd size responding to changes in the habitat, predation, and disease. Land use practices outside the Park are altering the quality and quantity of available deer habitat from the natural situation.

These external threats do not permit the Yosemite and Tuolumne Deer Herds from realizing their "natural abundance, behavior, diversity and natural integrity..." as called for in NPS Management Policy (1978). Outside agencies do cooperate with NPS in an effort to achieve, to the extent possible, the goals of all agencies involved.

Data used in the intensive management of the two deer herds are derived from herd composition counts and vegetation and pellet group transects using the key area/key species concept. The techniques currently used for data collection, analyses and intepretation were developed in the 1950's and have received severe criticism in the past ten years. The data do not accurately describe deer population dynamics nor range condition and trend. Consequently, a sound scientific basis for management is not available.

B. Past Actions: Limited field reconnaissance over intermediate and summer ranges have been conducted to determine key deer areas. A total of 34 permanent deer browse transects in 12 areas have been established. Pellet group counts, browse composition and condition, and range trends have been recorded for each area. Permanent photo points have been established on 14 of the 34 transects. In 1972, an extensive summer range survey was conducted by Forest Service, California Department of Fish and Game, Bureau of Land Management, and Park Service personnel. This interagency survey was designed to record present browse conditions on Yosemite's intermediate and summer ranges. A total of 126 random browse transects were read in nine areas.

Composition counts have been made annually since 1954 in cooperation with the California Department of Fish and Game. These counts have been mainly restricted to areas outside the Park on winter ranges.

In 1966 a three year trapping and marking program was undertaken. A total of 120 deer had one or a combination of identification markers. Observations of marked deer helped delineate approximate winter ranges and migration routes of deer.

Range surveys in 1964 showed heavy browsing of summer forage species by deer in portions of the Park. This was interpreted by the Park and California Department of Fish and Game as overbrowsing resulting from an overpopulation of deer. Between September 1965 and March 1966, the National Park Service removed 908 deer from the Yosemite Deer Herd through an in-Park reduction program.

Coincident with the NPS reduction program, the California Department of Fish and Game held antlerless and either sex hunts from 1965 through 1969. These hunts resulted in a reported kill of 2,384 deer.

In 1970 a memorandum of understanding covering the Yosemite cooperative deer studies was formulated to involve all groups and government agencies interested in the overall welfare of the Yosemite deer herds. The memorandum cites the California Department of Fish and Game, U.S. Forest Service, National Park Service, U.S. Bureau of Land Management, and the Boards of Supervisors of Tuolumne and Mariposa Counties as having legal responsibilities for management of deer herds and habitat within and adjacent to Yosemite National Park. It was decided that management goals for deer and their habitat can be reached only through coordinated efforts of these agencies with support of local citizens and their representatives.

The memorandum set up an advisory council made up of administrators of those agencies having legal wildlife or land management responsibilities. There also was one member from the board of supervisors and one member from other groups. The purpose of the advisory council is to recommend objectives for management of the deer herds, coordinate agency responsibilities and jurisdiction, recommend policies for conducting the Yosemite Cooperative Deer Herd Studies, have a place for an exchange of ideas and communications.

A technical committee was also established composed of biologists and representatives from the agencies on the advisory council. The technical committee is charged with the following duties:

1. Provide for exchange of ideas in developing plans, programs, techniques, and methods for management studies and recommendations.

2. Coordinate and assist with field studies.

3. Exchange information.

4. Outline other needed studies.

5. Provide findings to the Advisory Council.

Members of the technical committee carry out their studies throughout the year and meet at least once formally annually to exchange and compare data. The advisory council and technical committee meet jointly to review the data and formulate recommendations for management and future studies.

3. ALTERNATIVE ACTIONS AND THEIR PROBABLE IMPACTS:

A. No Action: The no action alternative would provide for the collection of no data. Without information, intelligent management would be impossible. Park Service input into land management practices and hunting regulations would carry little weight. Practices favoring intensive land use practices and intensive deer herd management for recreational hunting would prevail. The resulting deer populations would less resemble the desired NPS goal of a natural population.

This alternative would have no direct impact on the deer population. However, the possibility does exist for excessive herd reduction, or alterations in sex and age characteristics, due to active land and herd management with inadequate data.

B. Limited Monitoring: One alternative would be to continue with current techniques at the present level of effort. Park Service input into land management and hunting practices would carry a moderate amount of weight. The biggest drawback would be management with data that has an unknown correlation with reality. Consequently, management efforts will have an unknown affect toward reaching stated goals and objectives. The situation would be improved over Alternative A.

There would be no direct impact on the deer population or other environmental concerns. There would be less likelihood of excessive herd reduction or alteration of population characteristics than in alternative A, but the potential still exists.

C. Research Deer Population Dynamics: This research alternative would intensively evaluate existing and potential techniques for monitoring local deer populations and range to determine status and trend. It would be a highly quantitative study providing statistically significant confidence intervals around estimates. It would develop a population model that would demonstrate how different management techniques will affect the population over time. The results and techniques developed would be used by the Resources Management Division annually to monitor the deer populations and provide management input to outside agencies. This input would carry a great deal of weight. Land management practices and hunting regulations would be influenced to a greater degree. Although it is impossible, under the present circumstances, to totally achieve Park Service Goals, the deer population would reflect those goals to the greatest extent possible.

Adverse environmental impacts might include the stress of handling 16 to 20 deer for the purpose of attaching loose fitting collars with radio transmitters. Also up to 300 deer might be captured and tagged with metal cattle ear tags to determine sex and age composition data, ectoparasite loads, physical condition, reproductive status, and movements. All deer captured for these purposes would be immobilized with a central nervous system depressant by a highly trained and experienced biologist. Drug administration, short handling time, and supervision by a contracted veterinarian would serve to reduce stress to the animal.

D. Research Vegetation Communities: This research alternative would provide a quantitative description, map and identification key of vegetation communities and habitat types within Yosemite National Park and adjacent deer winter range. This study is necessary to establish valid monitoring techniques and identify critical range components.

No adverse environmental impact would occur from this study.

E. Research Deer Food Habits and Habitat Use Patterns: Other research needs include the documentation of food habits and habitat use patterns of deer and the effects of the Prescribed Burn Program on deer. These studies would help fine tune the monitoring program and modify burn unit size and schedule of burning to aid in achieving a more natural situation.

No adverse environmental impact would occur from this study.

4. RECOMMENDED COURSE OF ACTION

A. Monitoring Actions: Until improved methods are developed, continue with the current techniques at the present level of effort.

B. Research Actions: Conduct a research project designed to develop improved monitoring techniques that provide data with statistically sound confidence intervals and have a known relationship to real changes in the deer population. Also provide a deer population model, using attainable data to demonstrate how management actions and environmental changes affect the deer herd with time. Incorporate the findings of this project into the existing Resource Management Program to provide long term monitoring and assessment of deer population and range conditions and trend. Conduct a research project designed to quantitatively describe vegetation communities and habitat types in Yosemite National Park and on deer winter range outside the Park.

5. FUNDING:

A. Recurrent Funds Available in Park Base..............$22,000.00

B. O.N.P.S. Funds Requested............................$35,000.00

1. YOSE-N18-REINTRODUCTION OF BIGHORN SHEEP

2. STATEMENT OF PROBLEM:

A. Current Conditions: Currently no California bighorn sheep (*Ovis canadensis californiana*) are known to exist within Yosemite National Park. In 1914 bighorn sheep were declared extinct in Yosemite; however, at some period prior to 1914 a relatively large and widespread population inhabited Yosemite's high country. Since their declared extinction sightings have been reported periodically. The latest sighting occurred in 1975. Two herds exist in the southern Sierra Nevada. Unfortunately, neither herd represents a potential souce of natural reintroduction. California bighorn sheep are listed as "rare" by the California Department of Fish and Game.

B. Past Actions: The California bighorn sheep was officially declared extinct in Yosemite in 1914 but periodic sighting reports suggested that a remnant herd or herds existed. Reported sightings continued into the 1970's when it was deemed necessary to survey Yosemite to determine if herd(s) did exist.

Charles Hansen of the National Park Service and Dick Weaver of the California Department of Fish and Game participated in five aerial surveys. Fixed-wing aircraft were used July 25 through 27, 1972.

From 1975 through 1978, Wehausen (1979) conducted bighorn sheep studies in the Sierra Nevada including Yosemite. Winter and summer ground surveys were completed in 1976-1977 by teams of two investigators. One team spent 17 weeks in Yosemite during the summers of 1976 and 1977. Winter surveys were conducted by individual teams for seven weeks in 1977, and for a four and one-half week period and another nine week period in 1978. The four and one-half week survey was preceded by a fixed-wing aircraft flight to locate areas free of snow along ridges.

No bighorn sheep were observed nor signs indicating their presence during any of these surveys.

3. ALTERNATIVE ACTIONS AND THEIR PROBABLE IMPACTS:

A. No Action: The "no action" alternative would result in maintenance of the status quo; that is, no bighorn sheep present within Yosemite.

No further direct environmental impact would occur under this alternative. The extirpation of bighorn sheep resulted in the alteration of range species composition and abundance, as well as coincidental changes in predator distribution and abundance from the natural state.

B. Reintroduction of Bighorn Sheep in Lee Vining Canyon: Reintroduce surplus sheep from the Mt. Baxter Herd in the southern Sierra into Lee Vining Canyon. The objective would be to habituate these animals to new winter range. As the snows melt, the sheep will move upwards towards the crest with a high probability that the animals will eventually utilize the Yosemite high country during summer and fall.

The only adverse environmental impact of this alternative would be stress to the sheep during capture, transportation and immobilization to attach radio transmitter collars. Adjustments in vegetation species composition and abundance, with similar adjustment potentially occurring in predator populations. These adjustments are acceptable and desirable because they result from the reintroduction of an extirpated, naturally occurring species and restore the area to a more natural condition.

C. Monitor Reintroduced Bighorn Sheep: Upon completion of the proposed research project (see D below), begin monitoring of reintroduced bighorn sheep to determine status, trend and reproductive success of the herd. This program would be an annually recurring wildlife management project.

This alternative would result in no adverse environmental impacts.

D. Research: In order to reintroduce bighorn sheep, winter range must be available in or near the Park. As reported by Wehausen (1979) possible winter range may exist in the Hetch Hetchy area and/or in the vicinity adjacent to Lee Vining Canyon. Further investigations are needed to determine if suitable winter range exists in these areas.

A vegetation study is needed to provide a quantitative description, map, and identification key of vegetation communities and habitat types within Yosemite National Park and adjacent lands on the eastern boundary that have been identified as potential winter range. This study is critical for baseline data for determination of winter range and for potential studies of habitat use, movements and prediction of distribution and potential abundance of bighorn sheep following reintroduction. Upon completion of the vegetation study further investigation of areas identified as potential winter range is needed to determine if the requirements of winter range, other than vegetation composition are met.

If the alternative to reintroduce bighorn sheep is adopted, a research study would be necessary. This study would document the success or failure of the transplant and why. It would also determine seasonal movements, habitat use patterns, population dynamics and establish long-term monitoring procedures.

No adverse environmental impacts would result from the proposed research.

4. RECOMMENDED COURSE OF ACTION:

A. Resources Management Actions: Adopt the "no action" alternative. Wehausen (pers. comm.) has indicated that Lee Vining Canyon has the highest probability of possessing suitable winter range. The Forest Service initiated a research project in the winter of 1981 to determine if Lee Vining Canyon possessed suitable winter habitat. The study is tentatively scheduled to continue for five years.

Therefore, the prudent course of action would be to adopt the "no action" alternative and upon completion of the Forest Service research project reevaluate the need for further research.

B. Monitoring Actions: Continued monitoring of incidental observations.

5. FUNDING:

A. Recurrent Funds Available in Park Base.................$ -0-

B. O.N.P.S. Funds Requested..............................$ -0-
until completion of USFS study.

NATURAL RESOURCES PROJECT STATEMENT

1. YOSE-N19-VECTOR CONTROL

2. STATEMENT OF PROBLEM:

A. Current Conditions: Rodents, and on occasion other animals, transmit disease, or support parasites capable of transmitting certain diseases to man. The most important such vectors here are the California ground squirrel (*Spermophilus beecheyi*) and the Belding Ground Squirrel (*Spermophilus beldingi*), which serve as a reservoir for plague (*Pasteurella pestis*). Plague epizootics are also supported by various chipmunks (Eutamias spp.) and the golden-mantled ground squirrel (*Spermophilus lateralis*).

On rare occasions coyote (*Canis latrans*), spotted skunk (*Spilogale putorius*) and other carnivore populations harbor high levels of rabies. At such times, the possibility for transmission of the disease to humans is greatly increased over the normal situation. In Yosemite, unnaturally high densities of racoons (*Procyon lotor*) in developed areas, due to intentional and unintentional feeding by humans, results in a level of human contact with a resulting high potential for rabies transmission.

Plague detection occurs when a ground squirrel in a developed area dies for no apparent cause or demonstrates aberrant behavior. Such squirrels are collected and sent to the Bureau of Vector Control for examination.

Rabies detection occurs either when someone is bitten by a potentially rabid animal, or when a potentially rabid animal demonstrates aberrant behavior. In either case the animal is collected when possible and sent to the Fresno County Health Department for examination. The California Morbidity Report, published by the State Department of Health Services is read weekly to monitor rabies occurrence in adjacent communities.

B. Past Actions: In recent years, as a result of valid restrictions on the use of chemicals, control of California ground squirrels in concession, campground, and residence areas has been extremely limited.

One incidence of human plague was detected in Yosemite in 1959. Other outbreaks, without human contraction, occurred in Tamarack Flat Campground in 1975 and Tuolumne Meadows in 1977. In 1981, plague was detected in California ground squirrels at Glacier Point. The Bureau of Vector Control, California Department of Public Health in conjunction with personnel from Yosemite National Park sampled the area to determine the extent of infection and established bait stations in the area to dust the squirrels for fleas. The effort was successful in eliminating further spread of the disease.

In the 1960's, Yosemite had a coyote biting incident in Bridalveil Campground. U.S. Fish and Wildlife Service trappers removed 25-30 coyotes from the area to test for rabies. Conflicting reports suggest that either none or one animal tested positive. In 1974 five people were bitten by coyotes in the Wawona and Bridalveil Campgrounds. Four coyotes were destroyed, none of which proved positive for rabies.

3. ALTERNATIVE ACTIONS AND THEIR PROBABLE IMPACTS:

A. No Action: The no action alternative would provide for no method of detection of disease occurrence, and no management response if detected. The potential for transmission of potentially fatal diseases to humans would be high.

The only potential environmental impact under this alternative would be the likely spread of plague or rabies among susceptible wildlife populations with subsequent population reduction of unpredictable degree. The probability of spread is enhanced by unnaturally high densities of ground squirrels and racoons in developed areas.

B. Non-Systematic Monitoring: Under this alternative, disease detection would occur only from incidental observations of dead squirrels or animals demonstrating aberrant behavior that would be collected for disease testing. This is the technique used currently. There is a risk of non-detection of plague as ground squirrels become more resistant to the disease.

The potential for disease spread among wildlife would be reduced over alternative A, but still higher than in the natural situation. Any reductions in wildlife populations would be disease induced except for the individuals demonstrating aberrant behavior.

C. Systematic Monitoring: This alternative would provide a systematic technique for plague detection. A minimum sample of ground squirrels would be trapped in specified developed areas on an annual or biannual basis. This alternative would greatly reduce the risk of non-detection due to squirrels developing a resistance to the disease.

Environmental impacts of this alternative include a direct reduction of ground squirrel populations in developed areas. The sample size necessary for plague detection would still permit unnaturally high densities of ground squirrels and a potential for disease transmission higher than the natural situation.

D. Maintain Vector Populations at Some Reduced Level: This alternative would provide for the reduction of ground squirrels and/or racoons in developed areas to densities consistant with natural populations. Annual removal of individuals would maintain that level. This alternative would greatly reduce the spread of the disease among the rodent and carnivore populations and therefore, reduce the likelihood of transmission to humans.

The number of ground squirrels or racoons directly removed annually would depend upon the success of other programs such as elimination of feeding by visitors and refuse disposal. A concurrent monitoring program would insure that population levels do not fall below the natural situation.

E. Disease Elimination Upon Detection: This alternative would provide for management actions to be taken to stop disease spread once detected. For plague, ground squirrels and chipmunks would be dusted at insecticide-bait stations. Sampling of the population would be conducted in areas adjacent to the infected area to determine extent.

Any potential rabies vector demonstrating aberrant behavior or biting a human would be collected and sent to the Fresno County Health Department.

Any reductions in wildlife populations would be disease induced except for the direct removal of individuals demonstrating aberrant behavior. Invertebrate ectoparasites of chipmunks and ground squirrels would be drastically reduced in localized areas during dusting operations.

4. RECOMMENDED COURSE OF ACTION

A. Resources Management Actions:

1. Disease elimination upon detection.

B. Monitoring Actions:

1. Nonsystematic monitoring.

The above alternatives are recommended until a comprehensive management plan is developed. Such a plan must address public information and law enforcement options, facility design, and address the level of risk Park administrators are willing to accept. If other alternatives fail, options C and D above may be necessary.

5. FUNDING:

A. Recurrent Funds Available in Park Base..............$ 1,400.00

B. O.N.P.S. Funds Requested............................$ None*

*until development of a management plan

NATURAL RESOURCES PROJECT STATEMENT

1. YOSE-N24-SNOW SURVEYS:

2. STATEMENT OF PROBLEM:

A. Current Condition: The California Department of Water Resources (DWR) must take snow measurements throughout the major snowfall areas of this State for flood control, irrigation, water power generation, recreation, road maintenance and avalanche forecasting purposes. Under special use permit from the Service, the DWR operates a cooperative snow data collection network in Yosemite National Park consisting of 14 snow courses, 7 aerial snow depth markers, 6 storage precipitation gages, and 3 shelter cabins. The increasing need for more timely snow data, to forecast and manage snowmelt runoff volumes, requires more frequent collection of data than the once-per-month measurements presently obtained from the existing network.

Recently, the DWR proposed installation of an automatic snow sensor network to telemeter snow water content and associated data daily from the Tuolumne and Merced River watersheds in Yosemite National Park. After consultation with Western Regional Office and Park management personnel, a network of 10 automated data sites was selected to characterize snow conditions on these watersheds. An environmental assessment covering this proposal was prepared by DWR and approved by the Park Superintendent in July 1979. To date the 4 below-listed sensors have been installed: Dana Meadows, #157; Tuolumne Meadows, #161; Paradise, #167; and Gin Flat, # 179.

The following conventional snow courses continue to be measured up to 4 times each year: Snow Flat, #176; Tenaya Lake, #178; Rafferty Meadow, #158; Peregoy Meadow, # 180; Ostrander Lake, #177; Tuolumne Meadows, #161; Dana Meadows, #157; and Gin Flat, #179. The latter 3 courses are measured so data can be correlated with their automated counterparts.

B. Past Management Actions: Starting in 1926, under a Special Use Permit, a snow course was installed at Dana Meadow by downstream water users. The program was expanded in 1930, with a few more courses being added in the late 1940's and early 1950's. From the beginning, the Park measured the snow courses at scheduled times each winter. Some time in the late 1940's, overall responsibility for coordinating snow surveys fell to the California Cooperative Snow Surveys in the DWR.

For many years, there has been an active program involving 8 snow courses, 7 aerial snow markers, and 3 snow survey cabins, with financial support from the State. The Park has continued to read all snow courses by ski and Snocat while the DWR has monitored all aerial markers except one, which is the responsibility of the City of San Francisco, by fixed-wing airplane or helicopter.

In addition, at the request of the DWR, the Park regularly surveyed 3 snow courses on the Inyo National Forest.

3. ALTERNATIVE ACTIONS AND THEIR PROBABLE IMPACTS:

A. No Action: This alternative would leave all the snow courses and aerial markers, both active and abandoned, in place. Courses and markers could continue to be serviced and measured as they have been in the recent past.

B. Install and Operate a Total of Ten Automated Snow Sensors: Install 6 additional, automated, snow sensors, bringing the Park total to 10. Continue to operate the 8 active snow courses until the automated sensors are operating correctly. At that time remove all conventional snow courses and all remaining aerial snow markers and other inactive snow measuring devices.

C. Discontinue All Snow Survey Activities: Remove all snow survey stations and devices and discontinue all snow surveying activities.

D. Impacts on Natural, Cultural and Sociological Environments:

	Alternative A	Alternative B	Alternative C
Vegetation	No impact.	Some minor adverse impacts from installation of six automated sensors.	Some minor adverse impacts from removal of four automated sensors.
Wildlife	No impact.	Minimal short-term impacts from six installations.	Minimal short-term impacts from removal of four installations.
Endangered/ Threatened Species	No impact.	No impact.	No impact.
Air Quality	Insignificant short-term adverse impacts attributable to exhaust from use of helicopters, Snocat and pickup trucks in servicing or measuring snow courses or 4 automated sites.	Insignificant short-term adverse impacts attributable to exhaust emissions from helicopter, snocat & pickup trucks used in servicing automated sites.	Insignificant, short-term, one-time, adverse impacts attributable to exhaust emissions from helicopter use and dust from minor earth moving related to elimination of all snow survey facilities and devices.
Noise Levels	Minimum short-term noise pollution from helicopter, snocat and pickup truck use in servicing or measuring snow courses or 4 automated sites.	Minimal, short-term noise pollution from helicopter, Snocat and pickup truck use in servicing automated sites.	Minimal, short-term, one-time noise pollution resulting from helicopter use and removal of all snow survey facilities and devices.
Water Resources	Beneficial management impacts from data availability.	Beneficial management impacts from data availability much improved over Alternative A.	Adverse impact from loss of data availability.
Flood plain/Wetlands	No impact.	No impact.	No impact.

	Alternative A	Alternative B	Alternative C
Cultural Resources	No impact.	No impact. All sites would be cleared for cultural resource impacts before other actions were initiated.	No impact. All sites would be cleared for cultural resource impacts before other actions were initiated.
Health and Safety	Minor beneficial impact of Park Rangers travelling periodically to and from sites and being available for search and rescue and emergency medical service.	No impact.	No impact.
Aesthetic Quality	Minor adverse impact from visibility of snow courses and automated sites.	Adverse impact of automated sites would affect less people due to locations away from trails.	Short-term, minor, adverse impacts related to removal of courses and sites.
Existing or Future Uses	Would not adequately meet snow and water runoff information needs.	Would adequately meet snow and water runoff information needs.	Would provide no needed snow and water runoff information.

4. RECOMMENDED COURSE OF ACTION:

A. Monitoring: Alternatives A and C are both undesirable because neither would meet current or future needs for snow and water runoff information on a daily basis.

The recommended action is Alternative B which would replace up to 40 existing facilities (some already removed) with a network of 10 automated sites. New sites would be positioned less obtrusively than the existing ones, resulting in a reduction of visual impact, especially in the backcountry meadows. Site construction would require minor earth displacement to bury the snow sensing pressure tanks, the hydraulic lines, and to either form foundations for instrument shelters or to bury the wilderness type instrument box and set an antenna support pipe. Earth would be returned to original grade after completing the installation, with at least five centimeters (two inches) of native soil placed over the snow sensor tank surfaces.

Automated data sites in backcountry areas will be of the wilderness type which eliminates the erection of an instrument shelter and a precipitation gauge. Above ground elements of the site will be carefully placed to avoid visual impact, subject to the needs for tree canopy opening for the snow sensor and a 180° "window" to the south for operation of a solar panel (recharging device for buried batteries).

Present helicopter use for certain snow surveys will be phased out. Maintenance will be scheduled to insure that all preseason work is done by truck and foot in accessible areas and pack stock in wilderness. Emergency winter servicing of wilderness sites will be done by helicopter and the DWR will attempt to limit such work to no more than two visits per season per site if possible. Emergency servicing of nonwilderness sites will be done by skis, oversnow vehicle or helicopter in that order of performance. All helicopter use will be limited to the period between September 15 and June 15.

In addition to the four automated sites already installed and identified in section 2A above, the following automated sites would be installed:

Site Name	Site Number	Scheduled Installation
Snow Flat	176	Near Future
Ostrander Lake	177	Near Future
South Fork Merced Area	(Site and number to be selected)	Near Future

Site Name	Site Number	Scheduled Installation
Slide Canyon	825	1982
Merced Lake Area	(Site and number to be selected)	Near Future
Lower Kibbie Ridge	173	1982

5. FUNDING:

All funding for current or recommended actions is and would be, provided by the DWR.

NATURAL RESOURCES PROJECT STATEMENT

1. YOSE-N25-AIR QUALITY MANAGEMENT

2. STATEMENT OF PROBLEM:

Clean air is recognized as one of the park's natural resources. Air quality related values such as visibility of panoramas inside the park, clear and distant views to outside landscapes, and healthful, unpolluted air are essential to visitor enjoyment of Yosemite.

Congress explicitly stated in the Clean Air Act Amendments of 1977 that the Federal Land Manager has the affirmative responsibility of protecting a park's air quality and related values. In addition, Yosemite, under the Prevention of Significant Deterioration (PSD) Provisions of the Clean Air Act Amendments, was placed under Mandatory Class I status. Under the PSD Provisions for Class I areas (Section 169A), the Service is granted substantial authority and responsibility in "prevention of any future, and the remedying of any existing, impairment of visibility in mandatory class I Federal areas which impairment results from man made air pollution."

Environmental monitoring in the San Joaquin Valley and other parts of California show that air pollution has significant impacts on public health and resources, including visibility, water quality, vegetation and wildlife. The development and industrialization of the San Joaquin Valley, in particular, is a potential threat to the air quality resource within Yosemite.

The crux of the park problem rests on the lack of sufficient quantitative information on existing air pollutant levels and sources that impact the park, and the effects on air quality related values. To protect the air quality resource, it is necessary to collect baseline data to determine existing levels of air pollutants and, if possible, to identify the sources. Without accurate baseline data, Service officials have little basis upon which to evaluate and comment on existing and proposed developments, both internal and external, that may affect air quality. Until air pollution problems are identified, no management actions can be developed and implemented to correct or protect the air quality and related values.

Air quality monitoring instruments were first installed in Yosemite by the California Air Resources Board, in 1977. A Dasibi ozone monitor and recorder were located in Yosemite Valley for a period of two years, with one summer of monitoring carried out in Wawona as well. The State Air Resources Board installed the ozone monitor in order to compare data obtained from their normal monitoring stations with an area of lesser human activity. All costs and servicing of the monitor were carried out by the State Air Resources Board. Data obtained from Yosemite showed the park as having the second lowest ozone level in the San Joaquin Air Basin, with Modesto being the lowest.

On August 19, 1980, upon request of the Park Superintendent, the State Air Resources Board installed in Yosemite Valley, two high volume samplers to measure total suspended particulates, a carbon monoxide monitor, and a coefficient of haze sampling machine. The park asked for installation of monitors in order to obtain quantitative data on smoke from natural and prescribed fires.

The State had planned to remove the monitoring station October 31, 1980, since it was difficult for them to service the station due to its distance from the Air Resources Field Offices. However, data collected showed that Yosemite was in violation of the secondary federal suspended particulate standard on four occasions during the 2-1/2 month sampling period, and the State standard was violated on nine out of the eighteen days sampled. Because of these violations, the State Air Resources Board recommended that the park retain the hi-vol units and the coefficient of haze sampler for further monitoring and that park personnel be trained to operate the station.

During summer, 1981 the State Air Resources Board operated two air quality stations in Yosemite Valley. One contains two hi-vol units (one sample being taken every six days) and a coefficient of haze sampler running continuously. The State Air Resources Board trained one Resources Management employee in Yosemite, who now operates the station and services the monitors on a weekly basis.

The second station, a mobile air quality van unit, was operated for a three month period (July-September, 1981). The van was stationed at Camp 6 in Yosemite Valley and contained equipment necessary to monitor ozone, carbon monoxide, total hydrocarbons, oxides of nitrogen, wind speed and direction, coefficient of haze, total suspended particulates and visibility (a nephelometer). The State set up this additional temporary station to acquire a broader spectrum of readings than the permanent Valley station provides, and to obtain comparative readings for those elements already monitored by the permanent Valley station and other permanent stations throughout the state.

Yosemite Valley was selected for intensive air quality monitoring because it is believed to be the most sensitive area of the Park for all forms of air pollution and visibility problems. Throughout the year Yosemite Valley sustains a great concentration of people and automobiles, and in the summer there is the additional problem of campfire smoke from almost 1,000 campsites open to the public. Yosemite Valley functions as a collecting basin for smoke from wildland fires occurring in drainage basins leading into it due to the downslope movement of air at night. The concentration of smoke on the valley floor can be many times that on the nearby valley rim.

In addition to the former and on-going air quality and visibility monitoring stations, Yosemite has completed its "Integral Vista Identification" Project and the "Preliminary National Assessment of Class I Related Values: Visibility Report."

Yosemite coordinates all natural and prescribed fire management with the Mariposa, Tuolumne, and Madera Air Pollution Control Districts

(APCD) in order to insure that all permit and burn day requirements are satisfied. All natural and prescribed fires above 6,000 feet are currently exempt from APCD permits and burn day requirements even though they may significantly affect local air quality and visibility. Smoke from these fires, however, must be managed in accordance with County and State regulations for air quality.

The park has been recommended for installation of a visibility monitoring time lapse camera in the near future. The camera, provided by the Washington Air Quality Office of the National Park Service in Denver, would be set up at Crane Flat for a three month period. The sole purpose of establishing this station is to measure the extent to which regional haze is affecting visibility within the park.

In conclusion, air quality standards in Yosemite may already be exceeded or become exceeded in the near future. Unfortunately, the park does not have sufficient monitoring equipment to measure or predict the current or future status of the air quality resource. Without this data, damage to natural and cultural resources, a decrease in visitor enjoyment, and a possible increase in respiratory health hazards may result. The Service has legal mandates and a moral obligation to strive for acceptable air quality levels in the park, and the only way this can be achieved is through continually monitoring the air quality within the park, finding the air pollutant problems, and then developing management actions to rectify these problems.

3. ALTERNATIVE ACTIONS AND THEIR PROBABLE IMPACTS:

A. No Action - Discontinue Air Quality and Visibility Monitoring: Under this alternative, the existing air quality station in Yosemite Valley would be removed, and no further air quality work or planning would be done. While air quality and visibility elements could be monitored from stations outside the park, this alone would not produce data necessary to manage and protect the air resource within the park as mandated by the Clean Air Act as amended in 1977. External monitoring would merely provide us with one aspect of air quality management for the park - that is, information as to what pollutants may be drifting into the park from external sources and what sources may be producing these pollutants. However, no baseline data would be collected providing us with information about pollutants in the park that impact resources. In addition, concentrations of pollutants from internal sources could not be identified through an external monitoring program. Without monitoring, primary ambient air quality standards within the park could be violated, resulting in public health problems and the possibility of tort claims against the Federal Government for not protecting visitors. The only benefit of this alternative would be a reduced cost to the National Park Service in terms of manpower, time and expense saved by not operating a station.

B. Continue to Monitor Air Quality and Visibility at the Present Level: Under this alternative, the legal mandates to monitor air quality and visibility would only be partially satisfied. Data on particulate level and size would continue to be collected on a regular basis from the existing air quality station in Yosemite Valley. From this data, we would be able to determine whether particulate levels monitored by Hi-Vol units are a problem and, if so, develop management actions to relieve the problem. However, visibility and air pollutants would be monitored only on a sporadic basis, with temporary stations set up and operated by the California Air Resources Board. Sporadic monitoring of air pollutants does not produce the type of concrete and continuous scientific data necessary to identify problem pollutants and make management decisions. For instance, a pollutant that may degrade the air quality of the park considerably during one season (i.e., fire season), may not be present at any substantial level in another season and vice versa. Therefore, a pollutant that is a problem during a certain period of the year, may be monitored in its "off-season" and go unidentified as causing any air quality degradation. In order to meet the legal mandates and protect human and natural resources continuous rather than sporadic monitoring of all pollutants must exist, which makes this alternative unfeasible. This alternative would allow the park to identify certain but possibly not all air quality problems. Thus, management actions might be insufficient to address the entire air quality problem and meet requirements of the Clean Air Act.

C. Set Up an Improved Air Quality Monitoring System Within the Park: Under this alternative, at least one, and preferably four, air quality and visibility monitoring stations, would be established in the park. These stations would monitor ozone, oxides of nitrogen, carbon monoxide, suspended particulates (Hi-Vol Sampling), wind speed and direction, and visibility (regional haze). Each station would be set up in a different section of the park - Wawona, Hodgdon, Tuolumne, and Yosemite Valley - and would collect data on a continuing basis. The data would then be analyzed by the California State Air Resources Board to determine which pollutants, if any, pose threats to the park air resource or violate the primary or secondary ambient air quality standards. The results would then be sent back to the Park for review. The establishment of this type of monitoring system would enable the Park to (1) collect baseline data on all air pollutant types; (2) identify air and visibility problems and their sources and; (3) come up with management actions to solve the pollution problems. Management actions to solve pollution problems may include such items as restrictions on prescribed and natural fires, restrictions on campfires and woodburning stoves within the park, reduction of automobile traffic in the park through an improved shuttle service, or disapproval of a new industrial or development project within or external to the park. This alternative would provide the National Park Service with the level of monitoring necessary to assure that all legal air quality and visibility related mandates were being met. In addition, it would enable Resource Managers to come up with management actions to protect the air quality and visibility resource within the park. The adverse impacts of this alternative would be increased costs to the National Park Service in developing and operating a new management program and possible difficulties in trying to establish and coordinate a large monitoring system in the park with the California State Air Resources Board.

D. Research: A research project would be designed to study the generation of suspended particulates and other pollutants by fires, and the transport of these pollutants in smoke plumes to downwind locations. Such research would require information on available fuel by vegetation type, the amount of particulates and other pollutants generated per volume of available fuel, wind and smoke dispersal patterns over the Park and surrounding areas, and the rate at which various pollutants precipitate from smoke plumes into air layers adjacent to the surface. A research objective would be the development of a model designed to predict downwind concentrations of pollutants at various points inside and outside the Park based on the location, size, and probable course of a fire. Information on available fuel and dead fuel loadings by vegetation type, historical fire occurrence, weather, and predictive fire models is available for integration with additional research to produce this model. Additional research is needed to develop a vegetation type map and conduct a vegetation inventory for the Park.

Such a predictive system would allow managers to anticipate smoke related pollution problems in advance and to integrate these considerations into the management of natural and prescribed fires. This alternative could result in management decisions limiting the extent of natural fires in certain areas and the extent and timing of prescribed burning. Limits might also be placed on other pollutant sources such as combustion engines, campfires, and wood heaters. In this way, management would be able to insure compliance with national ambient air quality standards and to take preventive action when the standards are threatened.

Management actions resulting from this research could result in further disruption of natural fire regimes and natural processes in a wilderness environment as a trade-off for compliance with air quality standards.

4. RECOMMENDED COURSE OF ACTION

The preferred course of action would be alternatives C & D with the following additions:

A. Monitor internal air quality and visibility.
B. Continue present cooperative efforts with the County Air Pollution Control District and the California State Air Resources Board.

C. Become actively involved in county planning by assessing new industrial additions and their possible effects and impacts on the Park air resource.

D. Monitor all air quality related values including public health, water quality, vegetation, wildlife and cultural resources.

E. Develop a cooperative external monitoring program to expand our data base to include what pollutants may be drifting into the park from areas and sources outside the park.

The cost of implementing an air quality and visibility monitoring station under the recommended course of action would consist of installing and operating an NPS owned manual telephotometer and conducting a particulate research study. All other air quality monitoring equipment would be set up in cooperation with the State and County ARB's and would pose no expense to the park other than support costs for operating the station and coordinating between agencies.

5. FUNDING:

A. Recurrent Funds Available in Park Base.............$ 8,700.00

B. O.N.P.S. Funds Requested.........(1st year)........$207,500.00
(recurring).......$ 55,200.00

NATURAL RESOURCES PROJECT STATEMENT

1. YOSE-N26-RARE, THREATENED, OR ENDANGERED PLANT MANAGEMENT

2. STATEMENT OF PROBLEM:

The Endangered Species Act of 1973 (PL 93-205, 93rd Congress) as amended in 1978 (95th Congress) mandates the protection of listed plants and their critical habitats present on federally administered lands. Of over 3,000 candidate threatened or endangered plants listed in the Federal Register of Dec. 15, 1980 (45 FR 82480-82569), eight occur in Yosemite National Park or on the adjacent El Portal Administrative Site. One additional species occurs near and possibly in the El Portal Administrative Site as well. The Park Service is responsible for providing the Endangered Species Office with information on the status of candidate or proposed threatened or endangered plants within its jurisdiction to aid in determining their classification under the Endangered Species Act. The Act is intended to prevent further decline and to bring about restoration of endangered and threatened species and of the habitats upon which each species depends. Management of "critical habitats" for threatened and endangered plants, as well as for plants rare or unique to the Park, is an obligation and responsibility of the National Park Service (NPS Management Policies 1978).

Native plants and their habitats are recognized as an immensely valuable natural resource; the extinction of any species is an irretrievable loss of unique genetic material, any future usefulness to man, and an intrinsically valuable life-form. The ramifications of a decrease in the gene pool stability depend on the diversity of species within an ecosystem. Diversity provides an ecosystem protection against plant diseases and insect pests, ensures vigorous and vital stock for future breeding, and maintains healthy and dynamic plant and animal populations.

Most rare plants occupy niches in locally unique, unusual, or isolated habitats and are ecologically and geographically restricted, fragile, or otherwise specialized due to variously balanced combinations of climatic, geological, and biological factors. Little is known about the occurrence and habitat requirements of Yosemite's rare, threatened, and endangered plants. Without such knowledge, the continued existence of these species is uncertain.

Causes of rarity and threats to the Park's sensitive plant taxa need to be identified. Plant distribution and abundance can be caused directly or indirectly by natural biotic factors or by humans. Among the natural biotic factors are newly evolved competitive species, plant diseases, animal damage from over-grazing, insect damage, and the destruction of seeds and fruits. Many relict species have lost much of their genetic variability and are unable to adapt to evolutionary change. In these cases any disturbance or modification of a species habitat would be critical to its survival. Other rare species are newly evolved and have not yet had time to spread. These often are aggressive and capable of withstanding various threats.

Clarkia lingulata (potentially one of the Park's candidate endangered plants) is thought to be a young species that has not yet had time to occur in a wider range.

Known human threats to the Park's sensitive taxa are numerous. The most pronounced are increased recreational use of the Park and construction and real estate development in the El Portal Administrative Site as the General Management Plan is implemented. Identifiable treats are: construction; off road vehicles; tree removal; biocide spraying; introduction of competitive weeds; over-grazing by animals and associated trampling; human trampling; water management; introduction of plant diseases; air, water, and soil pollution; trail development and reconstruction; destructive fires due to heavy fuel loadings from 100 years of fire suppression; prevention of natural fires; and flower collecting.

The major problem is that little is known about the biology, habitat requirements, and extent of the Park's sensitive plant taxa. Protection alone may not be sufficient for the preservation and protection of rare, threatened, and endangered species; it is necessary to understand the reasons for species rarity and the specific causes of endangerment.

Of the eight candidate threatened or endangered plants residing in Yosemite or the El Portal Administrative Site, three (Eriophyllum congdonii, Eriophyllum nubigenum, and Lewisia congdonii) have sufficient status to support listing by the Endangered Species Office of the Fish and Wildlife Service. The Endangered Species Office is seeking further information on the other five species (Allium yosemitense, Carex tompkinsii, Cypripedium montanum, Erigeron aequifolius, and Trifolium bolanderi) prior to making any concrete proposals. An additional species, Clarkia lingulata has sufficient status to support listing as an endangered species, yet is not known to occur within the Park's jurisdiction. The Park is studying this plant due to the proximity of the only known sites to the El Portal Administrative Site. It will be necessary to survey likely areas to find out if this species occurs in the Park or the Administrative Site. Final determination and official listing of the above species is partially dependent upon information which the Park must provide. Seven of these plants occur in developed or high visitor use areas, or areas scheduled to be further impacted by the General Management Plan.

The California Native Plant Society's (CNPS) recent publication "Inventory of Rare and Endangered Vascular Plants of California" (1980) has listed 19 additional locally rare and sensitive plant taxa that are known or suspected to occur in Yosemite National Park. These additional sensitive species are:

Bolandra californica
Carex whitneyi
Ceanothus fresnensis
Chrysothamnus parryi
spp. bolanderi

Mimulus grayi
Mimulus laciniatus
Mimulus pulchellus
Perideridia bacigalupii
Phacelia platyloba

Clarkia virgata
Ivesia unguiculata
Lewisia disepala
Lupinus gracilentus
Mimulus filicaulis
Phacelia vallicola
Podistera nevadensis
Scirpus clementis
Trichostema rubisepalum
Wyethia elata

Field investigations must be conducted for these species to ascertain their rarity. If any candidate threatened or endangered species or those listed by the CNPS are found to be more abundant than had been previously expected, recommendations would be made to remove that species from the proposed and existing lists. The discovery of more populations or the demise of others will result in the shifting, adding, or removing of some species from the various categories.

Yosemite possesses 18 taxa that are locally rare and potentially sensitive to management decisions; these are:

Agrostis humilis
Anemone occidentalis
Cerastium beeringianum
Chaenactis alpigena
Claytonia bellidifolia
Claytonia nevadensis
Comostoma tenellum
Deschampsia atropurpurea
Draba praealta
Drosera rotundifolia
Erigeron vagus
Juncus abjectus
Juniperus communis var. montana
Myrica hartwegii
Polemonium pulcherrimum
  var. pulcherrimum
Salix nivalis
Saxifraga debilis
Veronica cusickii

The majority of these species are rare in the Sierra Nevada; occurring rarely or more commonly elsewhere. Three, Juniperus communis var. montana, Polemonium pulcherrimum, var. pulcherrimum and Salix nivalis, may reach their southern range limits within or very close to the Park. Draba praealta is known on the west slope of the Sierras from a single site on Mt. Gibbs in Yosemite. These stations offer invaluable opportunities to study the ecological causes of range limitations and the adaptive characteristics a species has evolved at the fringes of its critical habitat. If the single site of Draba praealta is not monitored and protected, this invaluable resource could be lost. Three locally rare taxa (Agrostis humilis, Anemone occidentalis, and Juncus abjectus) are known from so few sites in the Park that they could easily be obliterated by human-caused impact. Several taxa are alpine and subalpine species particularly susceptible to backcountry visitor impact. Mapping, photographing, monitoring, and status recording are critical for these locally rare and sensitive plant populations.

Most of the species on the Park sensitive plant list are also being investigated by the State of California Rare and Endangered Species Office. Information on plant status, distribution, and critical habitat collected in the Park will be considered in the listing process.

Known locations for eight of the nine candidate threatened or endangered plants have been identified from herbarium collections, floras, scientific literature and field surveys conducted by the NPS. The location of the ninth taxon, Erigeron aequifolius has been reported but not verified. The CNPS has mapped some known stations of the nine plants and has a photograph card file of plant collection labels. The Society has also summarized the status of endangered plants for the Forest Service. Dr. Carl Sharsmith, a long time Yosemite naturalist and recognized expert on the flora of the Park, has mapped several species' locations and has described their critical habitats. Resources Management maintains an on-going file for many of the sensitive Park taxa; this file contains maps, status reports, and photographs.

Literature searches and preliminary field investigations have provided the current distributional information for each of the nine candidate threatened and endangered plants that follow:

Eastwood (1922) first described Allium yosemitense from Bridalveil Creek above the falls. The type location was rediscovered by Alice Q. Howard in 1979, and re-evaluated by Steve Botti in 1980. This species is also known from near the summit of Devil Peak in Sierra National Forest. Seven new stations were discovered by NPS surveys in 1981.

Rare in the Sierra Nevada, Cypripedium montanum occurs in the coast ranges and the Rocky Mountains. This species is known from four stations in the Park: Hodgdon Meadows, Fort Monroe, Wawona, and Yosemite Valley.

Erigeron aequifolius has been reported but not relocated from Monroe Meadows (Badger Pass).

Eriophyllum congdonii was first described by Brandegee (1899) from near El Portal and redescribed by Constance (1937). This taxon was discovered along the South Fork of the Merced River and on Iron Mountain in 1981 by NPS surveys.

The type location for Eriophyllum nubigenum is from Cloud's Rest at 9,000 feet elevation (Gray 1883); subsequent searches in the area failed to relocate this particular site. In June 1980, this elusive species was rediscovered by Steve Botti at Chilnualna Falls where it was last seen 83 years earlier by J. W. Congdon. Four other stations, including three previously unknown ones were subsequently discovered in the Little Yosemite Valley - Mt. Starr King vicinity.

Lewisia congdonii has been collected in El Portal while its type location is listed as Mariposa County (Howell 19). It is known from four localities: El Portal and Chowchilla Mountain in Mariposa County, near Yucca Point along the Kings Canyon Highway in Fresno County, and on Iron Mountain along the South Fork of the Merced River where it was discovered by NPS surveys in 1981.

Trifolium bolanderi has been found in eight meadows near the type locality of Westfall Meadow (Gray 1867), and three meadows in Sierra National Forest.

Not definitely within the Park Administrative Site, Clarkia lingulata is known from only two places along the Merced River in Mariposa County (Lewis and Lewis 1955). Preliminary surveys through the El Portal Administrative Site have not located any new stations.

Locations of some of the rare and endangered plants listed in the "Inventory of Rare and Endangered Plants of California" (1980) are known within the Park. The locations, however, of at least eight species are unknown. The status of these 19 additional species must be ascertained since little is known about the Park populations.

Some of Yosemite's 18 locally rare and sensitive plants have status records on file. However, none or very little Park information is available for most of these species.

3. ALTERNATIVE ACTIONS AND THEIR PROBABLE IMPACTS:

A. No Action: The Park could confer no special protection to rare, threatened, or endangered plants and carry out no surveys to determine their status, distribution, and critical habitat. They would still be protected by standard Park regulations pertaining to disturbance of natural resources. The benefit of no action would be the avoidance of increased expenditures by the NPS. This alternative is not a viable one since the Park Service is required by law to identify and protect threatened and endangered species and their habitats. The Park Service must consult with the Endangered Species Office of the U.S. Fish and Wildlife Service on any project or action which has the potential to have adverse impacts on listed species. It is required by policy to consult on any project which has the potential to impact any proposed species. The no action alternative would require the Park to place existing or unknown populations of threatened or endangered plants in jeopardy by making management decisions affecting critical habitat without sufficient information. This would be in violation of either the Endangered Species Act or Park Service policy. The 1978 amendments to this act provide for any individual or organization to file suit for failure to adequately protect or preserve threatened or endangered species. In such a suit, the Park Superintendent could be held personally liable.

B. Use Current Information Supplemented by Sporatic Population Reports for Management Decisions: Potential habitat impacts could be assessed using current information on file and any occasional reports which might become available without systematic surveys. Known populations and their habitat would be afforded maximum protection under the Endangered Species Act. Sites for development projects would be surveyed for possible impacts on rare, threatened, and endangered plant species and the Park would enter into consultations with the Endangered Species Office when potential adverse impacts existed and when supplemental professional opinions would be required.

The benefit of this alternative would be the avoidance of increased expenditures and possibly enhanced protection of known populations.

This alternative could fail to provide accurate information on the true status of rare, threatened, or endangered plants in the Park. Many sporadic sightings of plants have been false, inaccurate, or incomplete. Recent systematic surveys have resulted in a greatly different assessment of the status of certain taxa than previous information would indicate. In most cases taxa have been found to be much more numerous and vigorous than previously supposed. In one case a taxon believed extinct was rediscovered after 83 years. Management decisions based on current information alone could unnecessarily delay or terminate projects, or could result in the extermination of unknown species. Under this alternative the Park would fail in its obligation to provide the Endangered Species Office with accurate information necessary to officially classify candidate and proposed species. Also, insidious and subtle impacts, such as trampling, habitat loss through fire suppression, camping overuse in critical habitat, and acid rain would not be assessed by this alternative.

C. Undertake Systematic Surveys of all Known Populations of Rare, Threatened, or Endangered Plants and all Potential Critical Habitat: Systematic field surveys would be undertaken to identify the distribution, critical habitat, and impacts on all species known or suspected to occur in Yosemite National Park. Surveys would entail mapping plant sites, counting and photographing individuals and recording information on human and natural habitat impacts, population vigor, condition, and predicted trend. Specific attention would be paid to site habitat characteristics and to changes in habitat near the outer edges of the site. Literature and herbarium searches would be undertaken in order to compile all available information on subject species.

This alternative would afford the maximum protection to rare, threatened, and endangered plants by providing management with accurate and frequently updated information on which to base its decisions. It would allow the Park to fulfill all of its obligations under the Endangered Species Act and would help to insure that subject species received the proper classification. The results of past surveys indicate that many plants are more widely distributed and numerous than previously supposed, and additional surveys will likely continue this trend. As a result, fewer special precautions will have to be taken for their protection and there will be fewer constraints upon Park development plans and visitor use. It is possible that Park development plans might have to be modified if their implementation would result in deleterious impacts on rare plant populations or habitat.

D. Research: A vegetation survey and a gradient model of the park's vegetation types is needed to make inferences of possible locations of sensitive plant populations. Once the critical habitat requirements of a particular species are known, computer generated maps could delineate geographic areas which possess similar characteristics. These locations would then be surveyed to confirm the presence or absence of a sensitive plant species.

Management surveys may determine that research is needed to quantify actual or potential impacts on rare plants and their critical habitats. For declining populations research would be necessary to determine the causes of rarity, loss of vigor, and decline in a population. This research might also provide suggested actions to aid in the recovery process. Research might be needed to define the relationship between particular species or varieties or to determine the validity of classifications.

4. RECOMMENDED COURSE OF ACTION:

Alternatives C and D are is recommended for the reasons previously stated. Alternatives A and B fail to provide adequate management as dictated by the Endangered Species Act and Park Service policy. Management decisions concerning rare, threatened, and endangered species will be greatly facilitated by the compilation of an accurate and complete data base. Protection alone may not be sufficient for the survival and recovery of rare plant populations; therefore monitoring of population levels and impacts is critical for effective management.

Status reports on each subject species will be written and revised as necessary. Individual population records, maps, and photographs will aid in relocating and identifying these plants. This will provide for more continuity in management and transfer of expertise between managers. Managers will be able to more quickly identify research needs, and this will facilitate the work of the Research Scientist. Management will also be able to concentrate on those species which are actually threatened or endangered rather than being forced to deal with a lengthy list of species based on spurious or incomplete data.

5. FUNDING:

A. Recurrent Funds Available in Park Base..............$ 7,900.00

B. O.N.P.S. Funds Requested............................$12,000.00

NATURAL RESOURCES PROJECT STATEMENT

1. YOSE-N27-WILDERNESS IMPACT MONITORING

2. STATEMENT OF PROBLEM:

Increased wilderness use in Yosemite National Park over the past 15 years has caused serious resource damage. Obvious impacts are: denuded campsites; multiple trails; accelerated erosion; compacted soils; unnatural vegetation changes; polluted water; disrupted wildlife habitat; and reduced opportunities for solitude. Wilderness resource impacts continue to accumulate and are compounded with time. It is Park Service policy and responsibility to preserve wilderness character and values. In addition, under the Wilderness Act (Public Law 88-577) the preservation of natural conditions and outstanding opportunities for solitude is a legal requirement for designated wilderness areas; Yosemite has 273,900 hectares (676,600 acres) proposed as wilderness and an additional 1,400 hectares (3,500 acres) proposed as potential wilderness.

Backcountry use increased 250 percent from 1968 to 1975, while Park use as a whole increased only 15 percent (van Wagtendonk 1979). Since 1974, annual backcountry use has averaged 198,000 visitor nights per year (van Wagtendonk and Benedict 1980).

Wilderness ecosystem alteration by elimination or introduction of materials or organisms and physical site alteration has had profound effects on the basic environmental wilderness regime. Wilderness environmental alterations tend to be concentrated in relatively small areas such as campsites, trails, meadows, streams, and lakes. Although heavily impacted locations are small relative to the entire wilderness they are often the most aesthetic and frequently visited. Continued physical and biological alteration could mean the demise of these wilderness attractions.

Generalized and specific wilderness resource impact studies, here and in other wilderness areas, have amassed enough information to warrant effective Park wilderness management. However, monitoring of use levels, management, and concessioner activities is necessary to assure the achievement of goals and objectives.

Briggs conducted a macroscopic study of Park backcountry "problems and considerations" from 1964 to 1965. Briggs noted that actual backcountry user counts greatly exceeded Park estimates. He also reported that concessioner-operated High Sierra Camps altered backcountry use patterns--people concentrate there and stress the surrounding wilderness.

Campsite denudation is a serious wilderness impact and Park management problem. Vegetation removal by trampling changes the functional ability, structure, composition, and successional patterns characteristic of the site (Hendee and others 1978). Grass and forb reduction at some campsites has increased surface runoff and erosion of organic and mineral soil. Heavy use has compacted soil and decreased soil moisture, increasing runoff and decreasing chances of seedling establishment and root penetration (Parsons and MacLeod 1980).

Holmes and Dodson (1976) found that trampling can damage low-growing vegetation but that the temporal use distribution in relation to a particular species growing cycle determined the impact severity and recovery rate. Recovery rates were high when the regenerative buds were at or below the soil surface, or the plant was near the end of its growing season. A Sierra Club report (Stanley and others 1977) on Sierran Wilderness group impacts also noted that impact severity on vegetative cover depended on the biotic community, time of use, and plant susceptibility. For example, higher elevation plants resist impact during their growing season but once severely damaged recover slowly.

Foin (ed. 1977) conducted a three year visitor-management impact analysis of Yosemite ecosystems. The study found that the primary forest impact is wood-gathering and understory suppression in front-country campgrounds. This is probably also true in the wilderness but to a lesser degree. The study also noted that effects on vegetative structure are extremely difficult to detect, especially indirect effects.

Firewood collecting alters the functional ability, structure, and natural successional pattern. When wood collecting, visitors trample surrounding vegetation and create unnecessary accessory trails. Live sapling and woody detritus removal disrupts nutrient cycling and plant succession (particularly in the sensitive subalpine and alpine zones where visitors are instructed not to build fires but frequently do). Intense, localized firewood collecting will cause soils to have less organic matter and be more apt to compaction and erosion. Cutting and sawing on living and dead whitebark pine near tree limit has caused serious destruction of the natural scene.

Campfires have adverse biological impacts. Within a fire ring the soil pH changes and minerals concentrate, often reaching toxic levels; no plant can recolonize the spot for years. Soil pH alteration affects nutrient availability and is highly restrictive for some plant species (Schreiner 1978). Fire rings tend to multiply in a camping area--spreading the above effects contagiously.

Human wastes are concentrated around campsites. Hendee (and others, 1978) found that human waste deposition reaches significant pollution levels in rest areas.

Holmes (1976) assessed user-caused impacts to representative wilderness lakes and streams near Tuolumne Meadows. All Park surface water he examined at times exceeded Federal standards for coliform levels in drinking water. In general, however, relatively little human fecal wastes were found in surface waters, bacteria being effectively filtered through ground water. Holmes suggested that pollution levels would respond better to qualitative rather than quantitative visitor use pattern changes.

Wilderness users often leave plastics and other refuse in campsites. Plastics can remain to mar the scene for countless years. Lee (1975) reported that Yosemite visitor satisfaction was related to the absence of litter on trails and at campsites. He noted that litter left by previous visitors was more disturbing to visitors than other forms of local environmental deterioration. The Backcountry trash cleanup program was eliminated in the early 1970's, though the problem remains.

Trails are wilderness travel arteries and therefore bear the brunt of extreme and continuing damage. Wilderness trail use has dramatically increased in recent years along with associated impacts: increased trail width and depth; multiple trails (particularty in meadows); cut switchbacks; litter and manure deposits; and vegetative disturbance. The dramatic increase in cross-country travel since the early 1970's has resulted in the proliferation of new unmaintained trails, especially in fragile alpine and subalpine areas. Specific environmental impacts have not been documented but erosion problems have been observed. The potential for irreversible adverse impacts is great in the higher elevations where cross-country travel is most popular.

Stock contribute to trail problems on many heavily used trails (especially trails to the concessioner-operated High Sierra Camps); stock often deepen and dig up trails by dragging their feet. Numerous hikers, avoiding the loose soil, rutted trails, or manure, walk along the margins of these trails, widen them and/or create new trails. Despite their greater relative impact, stock play an integral role in Park wilderness management and trail construction. It is probable that Park stock have less impact than concessioner stock.

Meadows are one of the most popular and visited wilderness ecosystems and are often the most sensitive to human activities. Pronounced meadow impacts are multiple trails, drainage alteration, and vegetation modification. Sharsmith (1961) examined the condition and ecological changes in seven of Yosemite's wilderness meadows due to visitor use. He compared the condition of these heavily used meadows with neighboring unmodified sites and found that the vegetational components of the meadows were clearly deteriorated from their natural state.

Hikers and stock physically alter meadows by trampling vegetation and compacting soil, causing accelerated erosion and disruption of water distribution patterns. In the lower elevations, edaphically and hydrologically altered meadows are quickly invaded by exotic plants introduced with horsefeed. All the above impacts can permanently alter the ability of the meadow to return to its original state.

Wildlife is an integral part of the wilderness environment, yet very little systematic research has been devoted to the wilderness recreationists' impacts upon wildlife numbers, distribution, and behavior. Although typical wilderness use probably produces a fairly brief and relatively minor impact on wildlife, visitation increases are augmenting total encounters and harassment. The high incidence of human-bear encounters and incidents in the wilderness indicates that current use levels and distributional patterns produce detrimental impacts on at least this major wildlife species.

To many people, solitude is an important wilderness feature; and maintenance of wilderness solitude opportunities is a legislative mandate. Increasing and concentrated use restricts the degree to which some visitors can find solitude. Although there are various techniques available to achieve solitude (e.g. travelling during the off-season or cross-country), opportunities for solitude are diminishing in heavily used areas of the Park's wilderness.

Park management has taken several steps toward reducing wilderness impacts. The current backcountry management plan stipulates a 25 person limit on hiker and stock party size for trails and crosscountry travel. In February, 1982, the limit for cross-country travel will become eight persons and stock per party. Stock parties must remain on designated cross-country or official trails and no stock party may exceed 25 head. Campsite location and wood fire use in subalpine areas is also restricted; no fire wood may be collected above 9,600 ft elevation. Wilderness permits are required for all overnight stays in wilderness areas. Backcountry rangers break up new fire rings in many areas to prevent the proliferation of related impacts. Management has attempted to reduce impacts by major trail reconstruction and relocation. Emphasis has been placed on eliminating multiple trails in meadows, making trails safer and more accessible to stock, and on eliminating trail erosion--especially on switchbacks. Existing drift fences have been maintained and no new drift fences have been built.

Since 1972 various quota types have been used to restrict and redistribute overnight wilderness use in Yosemite (van Wagtendonk 1979, 1981). A wilderness travel simulator developed by van Wagtendonk is used to track party size, type, arrival pattern, and route. Used in conjunction with trailhead quotas, this system allows managers to estimate the number, type, and location of users to expect in a particular wilderness area but not the type and extent of impact trends.

Until six years ago, popular camping areas were severely overcrowded during peak season; for example, Little Yosemite Valley had as many as 800 campers per night--a use level highly detrimental to the local environment and to an individual's appreciation of the wilderness experience. Since 1975, the quota system has allowed management to control these highly detrimental situations by temporally and spatially redistributing use. According to Ron Mackie (the Park's Chief Backcountry Ranger) the system is supported by a tremendous percentage of visitors (wilderness permit compliance is 90 percent) and its ease of administration reduces Park costs. Temporal and spatial redistribution of use has had some beneficial effects, but the ability of the quota system to reduce direct environmental impacts and promote full recovery of heavily impacted areas has not been quantitatively assessed, since baseline data on affected sites and impact trends is unavailable, and the system was not designed for this purpose. Quantitative observations by Park staff indicate that major problems remain and impacts are being compounded through lack of informed management. Some of the problems that are not correctable through the quota system are: trail closure and rerouting ineffectiveness in meadow areas; cross-country trail proliferation, particularly in fragile alpine and subalpine zones; improper waste disposal and its adverse effect on the environment and the visual resource; and high levels of site impact in the high elevations despite infrequent use.

According to Cole (1981), most research designed to assess the effectiveness of wilderness impact reduction strategies verifies Park staff observations that current Park management actions are unlikely to significantly reduce site specific impacts. Campsite and trail location and type of use are probably more important in most areas than level of use (Cole 1981). Visitor dispersal through quotas, and trail and site closures may actually lead to more widespread deleterious impacts without significantly reducing impacts in heavily used areas. This is true because most damage occurs from light use; heavy use thereafter causes little additional damage (Cole 1981). Light use, therefore, can cause fairly high levels of impact. Deterioration of campsites and trails occurs quickly while recovery occurs very slowly and only when use levels approach zero.

Most current research (Cole 1981) implies that management should consider strategies in addition to spatial and temporal redistribution of use in order to reduce impacts to an acceptable level. Such strategies might include relocating campsites or trails, and increased maintenance of the trail and campsite system. Cross-country routes might have to be either closed or maintained. Specific recommendations await a more quantitative assessment of impacts and trends.

In view of these findings, increased knowledge of impacts and impact trends is required to correctly formulate an effective management program.

3. <u>ALTERNATIVE ACTIONS AND THEIR PROBABLE IMPACTS:</u>

A. <u>No Action</u>: Wilderness management would continue under the present management plan and use quotas would remain in effect. Only subjective assessments of the effectiveness of management actions in reducing impacts would be available.

The benefits of no action would be the avoidance of expenditures necessary to carry out a monitoring program. The probability of major environmental restoration expenses in the future necessitated by the short term expediency of no action would offset any short term benefits.

However, cross-country trails are still appearing and older routes are becoming more heavily impacted. Many campsites, especially in subalpine areas, have recovered very little even though peak summer use has been reduced. Some subalpine campsites (e.g. Lyell Canyon) have probably become more heavily impacted and increased in size in recent years. Since research and observations indicate that current management strategy is probably ineffective, detrimental impacts would continue to accumulate. Continued resource degradation would visually impair many of the more popular wilderness areas, and reduce visitor enjoyment of the Park. As resource impacts accumulate and are compounded, the cost and difficulty of eventual restorative actions will increase.

B. Implement a Wilderness Resource Impact Monitoring System: A monitoring system would provide a baseline against which to measure future change and the effectiveness of current management strategies. Quantitative information would be gathered on changes in camp areas and sites such as: area of campsite, denuded area, artificial developments such as fire rings, sanitation problems, trampling, and vegetative alteration. Trails would be monitored for factors such as width, depth, and number of treads, erosion, troughing, drainage problems, and trailside vegetative changes. The proliferation of unmaintained trails due to cross-country travel would be documented.

Several monitoring systems have been developed and are in use in situations similiar to those in Yosemite. Monitoring would probably be based on the successful system presently in use in Sequoia-Kings Canyon National Parks (Parsons and MacLeod 1980) with a few modifications for trail monitoring. The precise techniques for gathering and processing data await further analysis.

If recommendations derived from wilderness impact monitoring are incorporated into management plans and decisions, the benefits would be: reduced impacts on fragile ecosystems such as meadows, lakeshores, and many subalpine forests; recovery of heavily impacted camp areas, campsites, trails; increased visual enjoyment of wilderness areas by visitors and thus a more rewarding wilderness experience; alleviation of sanitation problems; and a possible reduction in the proliferation of cross-country routes and the relocation, repair or elimination of some of these routes which are causing detrimental impacts.

This course of action would cause the following adverse impacts: minor visitor inconvenience when they encounter monitoring teams; possible reduced visitor access to and use of certain wilderness areas; increased Park expenditures for the indefinite future to fund the monitoring program; and possible modification of Park management and concessioner wilderness use.

C. Research: A research project capable of predicting the location of impact-sensitive areas is necessary since the monitoring program (alternative B) is not specifically designed for this purpose; the entire Park wilderness must be ecologically surveyed to correct or prevent further impacts. A comprehensive gradient model of the Park's vegetative communities would: enable managers to infer the location of particularly sensitive areas; aid in identification of presently impacted areas; and provide management with critical environmental information necessary for campsite and trail relocation projects. Additional research could be conducted on specific elements of visitor use and impact or site ecology as needs are identified by on-going monitoring.

Extensive research on the problems identified in this statement has been and is being carried out by many Parks and by the U.S.D.A. Forest Service. Research results indicate the necessity for a quantitative monitoring program as outlined in alternative B.

4. RECOMMENDED COURSE OF ACTION:

The no action alternative is rejected because it would fail to provide critical resource impact information needed to formulate effective management decisions. The recommended course of action consists of alternatives B and C since they provide the requisite information. Baseline data on existing resources and impacts and data collected in subsequent years on impact trends would be integrated with existing information on use levels and type to formulate effective management strategies.

The first year would involve preliminary surveys to determine the scope of the monitoring and the precedures to be used. In subsequent years teams of monitors would survey predetermined sites on a 3 to 5 year rotational basis to determine impacts and impact trends. The selected camp areas, campsites, and trails would be located in sensitive areas and would serve as indicators of impacts over broader but similiar areas.

5. FUNDING:

A. Recurrent Funds Available in Park Base..............$ None

B. O.N.P.S. Funds Requested...........................$36,000.00

NATURAL RESOURCES PROJECT STATEMENT

1. YOSE-N28-PEREGRINE FALCON MANAGEMENT

2. STATEMENT OF PROBLEM:

A. Current Conditions: Yosemite National Park has the only known active Peregrine Falcon nest site in the entire Sierra Nevada. Current use of organo-chlorine pesticides, especially DDT, by Latin American countries, and residual DDT in California, continue to pollute Peregrine Falcon prey in Yosemite to the level of 1 PPM in swallows and other migratory birds. Pesticide induced eggshell thinning threatens the existance of Peregrines in Yosemite. Eggshells were 18 percent thinner than normal in 1978. That female did not return in 1979. The presumably new female in 1980 had eggshells 13 percent thinned. Fifteen percent thinning is typically associated with nest failure in California. As Peregrines accumulate DDE (the metabolite of DDT), through continued feeding on polluted prey, eggshell thickness decreases and in approximately 3-5 years reproductive failure ensues. This pattern is typical and consistant in California Peregrines with eggshells 36 percent thinned in one instance. Reproductive success is unstable in Yosemite with one young fledged in 1978, none in 1979, two in 1980, and three in 1981.

Other threats to Yosemite Peregrines include visitor disturbance at nest sites which may promote cracking, dehydration or chilling of eggs with excessively thinned shells. Land use practices outside Yosemite but within California may affect the availability of Peregrine prey or directly increase mortality due to shooting, electrocution from utility wires or collision with wires or fences.

B. Past Actions: Grinnel and Storer (1924) documented the presence of Peregrine falcons in Yosemite in 1915. Other observers have reported two documented and one potential nest site and numerous sightings mostly in Yosemite Valley prior to 1949. No Peregrine sightings were recorded again until 1975. In 1978, rock climbers located and reported an active Peregrine nest in Yosemite Valley. Since that time two formal and many informal consultations have taken place with Dave Harlow of the U.S. Fish and Wildlife Service, Endangered Species Office in Sacramento. A Peregrine Falcon Management Plan was written in 1979, updated in 1980, and is presently under revision. The plan incorporated results of the consultations with the Fish and Wildlife Service including specific portions of the Park near active nest sites to be closed to visitor access from January 1 to August 1 annually.

The Santa Cruz Predatory Bird Research Group has been contracted annually to collect and measure eggshell fragments and prey remains. They also provide advice and a source of biological information. In 1980, 55 birds from 6 species of potential Peregrine prey were collected by Yosemite's Resource Management Staff and analyzed for DDE and other pesticide levels, in conjunction with a statewide survey funded by the U.S. Fish and Wildlife Service.

Beginning in 1981, a three-year research project was initiated to determine present population levels of Peregrines in Yosemite. It will also evaluate and prioritize Peregrine habitat and recommend future management actions.

3. ALTERNATIVE ACTIONS AND THEIR PROBABLE IMPACTS:

A. No Action: The no action alternative would provide no way of determining success or failure of Peregrine nesting attempts, no evaluation of human disturbance, no method of protecting or enhancing the population, and no way to determine if the population is extinct or thriving.

No direct environmental impact would occur under this alternative, but failure to act might lead to local extinction.

B. Incidental Monitoring: Incidental monitoring of active nests could document nesting attempts with a moderate probability of success. Nest failure could never be documented with any surety. It could not provide a basis for nest augmentation.

Environmental impacts would be the same as in alternative A.

C. Continous Active Nest Monitoring: Continous monitoring of active nests would document, with high probability, nesting attempts by known sex and age class birds, number of young fledged, nest failure, the state of reproduction at which failure occurred, and the precise timing of each phase of reproduction. It would provide a sound basis for determining if nest augmentation efforts were necessary and when the attempt should be made.

Monitoring will be done from an adequate distance from the nest sites to preclude any impact on the species.

D. Eggshell Fragment Collection: The annual collection of eggshell fragments from active nests would permit evaluation of the impact of organo-chlorine pesticides on eggshell thinning and the potential for reproductive success in subsequent years. It would provide a basis for evaluating the need for nest augmentation efforts the following year.

Eggshell fragments would be collected after the young have fledged and have lost their close psychological attachment to the nest. Consequently, their would be no adverse environmental impact from this alternative.

E. Systematic Potential Nest Monitoring: Systematic monitoring of potential Peregrine nest sites will provide a basis for monitoring population expansion. At the conclusion of the research project currently in progress, this will be the principle means of locating new nests. It's an important factor in determining population stability and if, when and where hacking efforts should be conducted.

The environmental impact would be the same as alternative C.

F. Incidental Potential Nest Monitoring: Incidental monitoring of potential nests may provide similar information as alternative E, but with a much lower probability of success.

The environmental impact would be the same as alternative A.

G. Area Closure: Impose a Superintendent's Closure as necessary in the vicinity of active nest sites. This alternative would minimize accidental human disturbance of the birds.

This alternative would reduce human interference resulting in no adverse environmental impacts. Closures would reduce recreational opportunities of the small number of rock climbers who use such terrain.

H. Nest Augmentation: Nest augmentation is the process of removing whole eggs from a nest that are suspected of being too thin to successfully hatch young, and replacing them with healthy, young nestlings hatched in captivity. This alternative will insure the successful fledging of three young per nest annually, when the adults are incapable of doing so on their own.

This alternative would be conducted under strict, scientifically based guidelines, to insure the most successful techniques are used. The net result would be an increase in Peregrine population size to the natural level. Impacts on Peregrine prey would include a change in causes of mortality but probably no change in overall prey abundance. Consequently, no adverse environmental impact is recognized.

I. Hacking: Hacking is the process of taking captive reared young and training them to hunt and survive in the wild. It is useful for establishing new nesting pairs.

The environmental impact of this alternative would be the same as for alternative H.

J. Research Peregrine Movements and Food Habits: This research alternative would provide answers to two questions. First, it would determine the food habits of Peregrines in Yosemite, which will provide a basis for evaluating the impacts of organochlorine pesticides and a predictive model for nesting success or failure. It will also determine winter movements of Yosemite Peregrines to aid in identifying and protecting critical habitat.

All research actions would be done from a safe distance except for the application of radio transmitters, if used, to document movements. Transmitters would only be attached to captive reared birds used in hacking or nest augmentation efforts. Consequently, no adverse impact would occur to existing wildlife populations.

K. Research Vegetation Communities: This research alternative would provide a quantitative description, map and identification key for vegetation communities and habitat types in Yosemite National Park. An extensive inventory of Peregrine prey species abundance would be extremely expensive and its value of narrow scope. An acceptable alternative is to describe and map vegetation characteristics that are essential components of each prey species habitat. This information could allow the prediction of prey occurance and be used to focus our ongoing search for active Peregrine nest sites. It will also enhance the findings of the current Peregrine research project. It will also be of value to other resource management needs.

No adverse environmental impacts would occur under this alternative.

3. RECOMMENDED COURSE OF ACTION

A. Resources Management Actions:

(1) Close areas as necessary to prevent human disturbance at nest sites.

(2) Augment nests whenever eggshell thinning exceeds 15 percent.

(3) Hack young birds into wild when less than two pairs of Peregrine Falcons maintain active nests in the Park or immediate vicinity. These two nests should be successful either naturally or through augmentation efforts.

B. Monitoring Actions:

(1) Collect eggshell fragments annually from active nests to evaluate pesticide level and potential for reproductive failure.

(2) Continuously monitor all known active Peregrine nests to determine reproductive efforts, success and timing. This information is essential to determine if and when nest augmentation is necessary.

(3) Systematically monitor high priority potential Peregrine nest sites annually to evaluate population expansion. Lower priority sites should be monitored every two to three years. This information plus that identified in 2 will determine if, when and where hacking efforts should be initiated.

C. Research Actions:

(1) Complete current survey to evaluate Peregrine falcon status in Yosemite.

(2) Complete current Peregrine habitat analysis to prioritize potential nest sites.

(3) Determine relative abundance of each prey species in food habits of Peregrines in Yosemite to evaluate impact of pesticide use outside United States and to project population trends in future as a basis for funding requests and management actions.

(4) Determine winter movements of Peregrines outside Yosemite to evaluate potential impact of other mortality factors and to identify critical habitat outside the Park.

(5) Conduct quantitative vegetation analysis to evaluate habitat quality for Peregrines.

5. FUNDING:

A. Recurrent Funds Available in Park Base.............$ 5,200.00

B. O.N.P.S. Funds Requested..........................$26,500.00

NATURAL RESOURCES PROJECT STATEMENT

1. YOSE-N29-WOLVERINE MONITORING:

2. STATEMENT OF PROBLEM:

A. Current Conditions: Wolverine sightings in Yosemite National Park and vicinity occured from as early as 1892 and extend to the present. Sightings are extremely rare, however, averaging six per decade over the past sixty years.

Wolverines are identified as a rare species (equivalent of threatened on Federal List) by the State of California, and, therefore, should be managed as such in Yosemite. Nothing is known regarding wolverine habits in this area so no assessment of the potential impacts of management actions and visitor use is possible.

B. Past Actions: Past actions include the recording of incidental observations and a contracted literature review and survey of records of occurrence in 1974.

A winter field survey was conducted on adjacent Forest Service land in 1978 which found no evidence of wolverine occurrence. Another winter field survey was conducted by two college seniors as a senior thesis project in 1981. They spent three months in the northern end of the Park and adjacent Forest Service land and found no evidence of wolverine occurrence.

3. ALTERNATIVE ACTIONS AND THEIR PROBABLE IMPACTS:

A. No Action: The no action alternative would provide no information regarding the status and trend of the wolverine population.

Adverse human impacts could not be identified and corrected. The wolverine population might exist at a reduced level or possibly suffer local extinction. Any such impact in the central Sierra's might have serious repercussions in already stressed populations to the north and south.

B. Research Wolverine Population Status and Trend: This research alternative would provide information about the present status of the wolverine population and whether it is increasing, decreasing or stable. If wolverine occur in sufficient numbers to justify the application of radio transmitters, then movements, habitat use patterns, and potential human impacts could be assessed.

The only potential environmental impacts would be the stress to an individual animal of live capture, handling, and the affixing of a collar fitted with a radio transmitter. This step would not be undertaken unless sufficient evidence exists to assure this action would not stress the population as a whole.

C. Research Vegetation Communities: This research alternative would provide a quantitative description, map and identification key to vegetation communities and habitat types in Yosemite National Park. Quantitative vegetation data, collected in such a way as to relate to the habitat requirements of both the wolverine and its prey, would serve as a basis for evaluating habitat quality in the Park and for establishing sampling strategy.

This alternative would result in no adverse environmental impact.

4. RECOMMENDED COURSE OF ACTION:

A. Research Actions:

(1) Research Wolverine Population Status and Trend.

(2) Research Vegetation Communities.

5. FUNDING:

A. Recurrent Funds Available in Park Base..............$ None

B. O.N.P.S. Funds Requested............................$ None*

*until development of a management plan

NATURAL RESOURCES PROJECT STATEMENT

1. YOSE-N30-GREAT GRAY OWL MANAGEMENT

2. STATEMENT OF PROBLEM:

The Great Gray Owl was recently listed as "endangered" by the State of California. Adverse visitor and employee impacts on this species are strongly suspected. Further investigation is necessary before a complete project statement can be written.

3. FUNDING:

A. Recurrent Funds Available in Park Base..............$ None

B. O.N.P.S. Funds Requested............................$ None*

*until development of a management plan.

NATURAL RESOURCES PROJECT STATEMENT

1. YOSE-N32-VEGETATION ANALYSIS FOR NATURAL AND CULTURAL RESOURCES MANAGEMENT

2. STATEMENT OF PROBLEM:

A. Current Conditions: During the 130 years that Europeans have been associated with the central and southern Sierra Nevada, vast changes have occurred in many of the region's vegetative and wildlife communities (Vankat and Major 1978). Since the establishment of Yosemite National Park in 1890, managers have often pursued management policies that were inconsistent with the present Park management objective of maintaining all natural ecological processes (Gibbens and Heady 1964; Heady and Zinke 1978). Past policies dealing with fire suppression, visitor use, wildlife, grazing, introduction of exotics, insect and disease control, and construction of park facilities have significantly altered the composition and structure of plant communities throughout the Park. The significance of most of these changes is impossible to evaluate because of the lack of comparative baseline vegetation data.

Every resource management program, described in this plan has either a direct or indirect effect on the Park's vegetation. However, Park ecosystems are being altered by ecological processes and outside sources, as well. Technological and agricultural activities outside the Park are threatening the integrity of Park ecosystems. Air pollution differentially affects plant species' vigor and susceptibility to insect and disease attack. Acid rain can drastically change water and soil chemistry, and directly impact vegetation. These impacts have the capability of both subtly and dramatically changing the composition, structure, and distribution of the Park's vegetative and wildlife communities in a relatively short period of time.

Fire and wildlife management programs are limited by the quality of the information on which they are based. Fire behavior and wildlife species are directly affected by vegetation and physiography. The lack of accurate, detailed, and current vegetative information has made the development and implementation of site-specific fire and wildlife management programs deficient for much of the Park. No system is available for accessing and integrating the limited vegetation information that has been obtained from research and resources monitoring programs.

Management of wilderness and backcountry areas requires knowledge of the myriad ways in which users interact with the natural environment. The susceptibility of ecosystems to human impacts, and the prospects for rehabilitation, are directly related to vegetation, soil, climate, and physiographic parameters. The lack of accurate, detailed, and current vegetation-environment information has made the development and implementation of site-specific backcountry management programs difficult for much of the Park.

Information about the Park's vegetation, topography, geology, and other natural elements is needed by archaeologists to predict the locations and identify potential impacts. Within the five percent of the Park which has been surveyed for archaeological sites, less than 600 sites have been recorded. It is estimated that there are an additional 900 sites located within the Park's boundaries. Coordination of cultural and natural resources management activities is essential for the preservation of all of the Park's resources. Management programs for fire, wildlife, and visitor use pose potential threats to the Park's historic and prehistoric sites.

Vegetation, wildlife, fire, wilderness, and archaeological research and monitoring that has been done or is being conducted in Yosemite National Park are providing some of the information needed by managers for planning and decision making. However, many of these management programs do not have the benefit of a database for extrapolating research results from one area to another.

B. <u>Past Actions</u>: A cover type map of Yosemite's vegetation was completed in the 1930's. This map depicts the dominant vegetative cover by individual species or groups of tree species. Mapping was accomplished during the 1930's by occular methods without the aid of aerial photography.

In addition to the cover type mapping, the 1930's field crews sampled 670 vegetation plots that were located throughout the Park. The sample plots were intended to be representative of the average conditions within a given cover type (Coffman 1934). In addition to the cover type mapping and the reading of the 670 sample plots, photographs were taken to illustrate each cover type.

The most detailed site-specific vegetation-environment studies here were initiated in 1961 to: 1) chronicle events that influenced the Yosemite Valley landscape from 1851 to the present (Gibbens and Heady 1964); 2) make a detailed soil survey of the Valley (Zinke and Alexander 1963); 3) quantify the Valley's meadow vegetation (Ziegler and Heady 1964); 4) measure the vegetation of the Valley (Ziegler and Heady 1965); and 5) collect information on recent vegetational changes in the Valley (Heady and Zinke 1978).

3. <u>ALTERNATIVE ACTIONS AND THEIR PROBABLE IMPACTS</u>:

A. <u>No Action</u>: The no action alternative would not provide for the collection, analysis, and interpretation of vegetation information to build upon that obtained from the 1930's cover type project. Park programs would continue to be implemented in an informational vacuum. However, crash programs to gather data will be undertaken for crisis situations.

Without current, detailed, and easily accessible information about the Park's vegetation and its relationship to other resources and programs, informed management would be impossible. It would be difficult to evaluate the effects of current and future resources management programs on the Park's vegetation. Long-term monitoring of vegetation changes that result from natural and man-caused influences such as prescribed burning, air pollution, or acid rain would be difficult to evaluate.

This alternative has the potential to significantly impact the Park's ecosystems if it is selected. Since insufficient information would exist for decision making, managers would not be able to reliably predict the consequences of their actions and management actions might be contrary to the intents and purposes of the stated objectives of this Natural Resources Management Plan and the National Park Service.

B. Reanalyze the 1930's Sample Plot Data: Using one or more of the new mathematical tools for arranging samples along environmental axes, the data from the 670 plots measured in the 1930's would be used to develop a more useful classification and ordination of the Park's vegetation. This revised classification would be used as the basis for mapping the vegetative communities of the Park using the densitometer data obtained from multi-spectral aerial photography that will be flown during the summer of 1982.

This alternative would produce a more accurate and detailed vegetation map than currently exists but it would be based on data that was collected 50 years ago. The revised vegetation map would necessarily ignor the changes that have occurred in the Park's vegetation in the last 50 years.

The measurements taken at each of the 670 plots in the 1930's are relatively crude by today's standards of measurement and analysis. Much more detailed and thorough measurements are required in order to meet the predictive requirements of the Park's resources management programs.

C. Habitat Type Classification and Mapping: This alternative would remeasure the 670 sample plots from the 1930's and then use the new vegetation data to develop a habitat type classification. Analysis of the vegetation data would proceed through a series of successive approximations utilizing synthesis tables, ordinations, environmental data correlations, and field-testing of the preliminary classification.

A Park habitat type map would be generated by a computer using multi-spectral aerial photographs. The spectral signature of each habitat type would be calculated by averaging the exposure values of all sample stands within that habitat type. A computer would use these spectral signatures to sort the data obtained from densitometer scanning of the infrared photographs and plot the habitat type map. The map would be field-checked for accuracy.

This alternative would produce a vegetation map and habitat type classification that would be superior in terms of resolution, accuracy, detail, and usefulness to the existing cover type map of the Park's vegetation.

The primary problem with this approach is that it treats plant communities as discrete units that possess average characteristics. The structure, composition, disturbance history, and physical and chemical environments of a plant community vary tremendously in space and time. Community characteristics inferred from such an approach would probably be too general for site-specific resources management planning.

D. Gradient Modeling Approach: The gradient modeling approach (Kessell 1976, 1979a, 1979b) arranges samples from communities along one or more environmental gradients. These spatial and temporal environmental gradients (elevation, aspect, topographic position, length of time since last disturbance, type of disturbance, etc.) affect the structure and composition of plant communities. Kessell's (1975) Basic Resources and Fire Ecology Systems Model for Glacier National Park would serve as a model system for Yosemite. Such a model would have three components:

(1) Gradient Model:
Gradient models would provide quantitative community inferences based on the location of each stand within the gradient matrix.

(2) Inventory:
Remote site-specific inventories developed from topographic maps, orthophotos, aerial photography, and disturbance history would identify each stand on each gradient.

(3) Integration:
A computer program to link the models with the inventories would enable the user to enter the geographic coordinates of a stand and obtain from the program a variety of information about the structure and composition of the vegetation, wildlife, fuel, etc. at that point.

The greatest strength of the gradient analysis approach is the ability to deal effectively with continuous variation. Increasingly, gradient analysis and ordination are being used in the development of classification systems. The major disadvantage of employing this approach is the effort needed for field sampling, digitizing, and organizing the information into a useful format.

Adverse environmental and sociological impacts would be limited to those from the excavation and backfilling of approximately two hundred 12 x 12 inch pits for soil analysis, the collection and herbarium storage of several hundred plant specimens and the very short-term impact of the aerial photography flights.

4. <u>RECOMMENDED COURSE OF ACTION:</u>

A. <u>Vegetation Analysis Project</u>: Integration of the alternatives B, C, and D will provide the Park with a comprehensive understanding of Yosemite's complex plant communities. The broad research design necessary to develop an integrated vegetation analysis system for the Park is outlined below.

The first objective of the Vegetation Research Project is to develop an Ecosystem Information And Resources Management Model for Yosemite National Park which possesses the following components and capabilities:

(1) Description and understanding of complex vegetation patterns on three levels - environmental factors, species populations, and community characteristics.

(2) Understanding and prediction of changes in complex vegetative communities that result from management actions and natural processes.

(3) Using vegetation information to infer other ecological properties: fire behavior; wildlife habitat suitability, quality and trend; sensitivity to human impact; and, locations of archaeological sites.

(4) An integrated database which is easily accessible and produces analyses that are useful in resource management planning and decision making.

A vegetation classification system for the Park will be developed using ordination. A key will be prepared so that individuals may quickly and accurately identify a particular plant community. The classification and key will correspond closely to the habitat type classification developed by Daubenmire and Daubenmire (1968) and Pfister and others (1977) for forest communities in the northern Rocky Mountains.

The Park vegetation will then be mapped at a scale of 1:24,000 using the habitat type classification developed above in conjunction with multi-spectral photography.

5. <u>FUNDING:</u>

A. Recurring funds available from Park Base..........$ 42,640.00

B. ONPS (NS) funds requested..........................$ 66,600.00

REFERENCES

Abrams, L.R. 1923. An illustrated flora of the Pacific States. 4 Vol. Stanford Univ. Press, Stanford, Calif.

Andrews, T. 1978. A winter field survey of the Mono Lake Ranger District for wolverine and other furbearers. Unpub. 15 p.

Ayensu, E.S. and R.A. DeFilipps. 1978. Endangered and threatened plants of the United States. Published jointly by the Smithsonian Institution and the World Wildlife Fund, Inc. Washington, D.C. 403 p.

Badger, T.J. 1975. Rawah wilderness crowding tolerances and some management techniques: an aspect of social carrying capacity. M.S. thesis, Colorado State Univ., Ft. Collins, Colorado. 83 p.

Barbee, R.D. 1969. Resources management plan, Yosemite National Park. Unpub. National Park Service Document. 125 p.

Bendell, J.F. 1974. Effects of fire on birds and mammals; In: Fire and ecosystems. p. 73-138. T.T. Kozlowski and C.E. Ahlgren, eds. Academic Press, New York.

Biswell, H.H. 1961. The big trees and fire. Nat. Parks Mag. 35:11-14.

____________. 1973. A summary of research on smoke and air pollution from forest and wildland burning. Arizona Water Commission Report #5 p. 28-33; proceedings from the 17th Arizona watershed symposium, 1973.

____________. 1974. Effects of fire on chaparral; In: Fire and ecosystems. p. 321-365. T.T. Kozlowski and C.E. Ahlgren, eds. Academic Press, New York.

____________, H. Buchanan, and R.P. Gibbens. 1966. Ecology of the vegetation of a second growth sequoia forest. Ecology 47(4): 630-633, illus.

Bonnicksen, T.M. 1975. Spatial pattern and succession within a mixed conifer-giant sequoia forest ecosystem. M.S. thesis, Univ. Calif. 239 p.

____________, and E.C. Stone. 1978. An analysis of vegetation management to restore the structure and function of presettlement giant sequoia-mixed conifer forest mosaics. A report prepared for the U.S. Nat. Park Service by the Univ. Calif, Berkeley, California. 159 p.

Botti, S.J. 1978. Final report on the El Capitan Crossover and Moraine prescribed burns. Resources Management Office, Yosemite National Park, California.

__________. 1981. Memorandum to the Western Regional Director from the Acting Superintendent listing Yosemite's rare, threatened, and endangered plant taxa. Yosemite Nat. Park, California. Jul 8. 3 p.

Brandegee, K. 1891. The flora of Yo Semite. Zoe 2:155-166.

__________. 1899. Proc. Gaz. 27:449.

Briggs, G.S. 1964-1965. A report on backcountry conditions and resources, with management recommendations. Yosemite Nat. Park, California. Unpub. Nat. Park Service Report. 214 p.

Bruggeman, R., Supv. Wdlf. Mgr., Calif. Dept. Fish and Game - Reg. 4, Fresno, Calif.

California Department of Fish and Game. 1980. At the crossroads. A report on the status of California's endangered and rare fish and wildlife. 147 p.

Cattelino, P. J., I. R. Noble, R. O. Slatyer, and S. R. Kessell. 1979. Predicting the multiple pathways of plant succession. Environmental Management 3(1): 41-50.

Caughley, G. 1974. Interpretation of age ratios. J. Wildl. Man. 38(3):557-562.

Cella, W.B. 1981. Human/Bear management plan. Yosemite National Park. Unpubl. NPS Document. 21 p.

Cella, W.B. and J.A. Keay. 1980. Annual bear management and incident report. Yosemite National Park. Unpubl. NPS Report. 24 p.

Claar, J.J. 1973. Correlations of ungulate food habits and winter range conditions in the Idaho Primitive Area. M.S. thesis, Univ. Idaho, Moscow. 85 p.

Cobb, F.W., Jr., Prof. of Plant Pathol., Univ. Calif., Berkeley, Calif.

Coffman, J. D. 1934. Suggestions for the mapping and study of vegetative cover types in areas administered by the National Park Service. USDI, National Park Service, Branch of Forestry. Washington, D.C.

Cole, D.N. 1978. Estimating the susceptibility of wildland vegetation to trailside alteration. J. Appl. Ecol. 15:281-286.

__________. 1981. Managing ecological impacts at wilderness campsites: an evaluation of techniques. J. Forestry. Feb. p. 86-89.

Cole, G.F. 1971. An ecological rationale for the natural or artificial regulation of native ungulates in parks. Trans., 36 N. Amer. Wildlf. Conf. 18 p.

Congdon, J.W. 1904. Muhlenbergia 1:38.

Constance, L. 1937. A systematic study of the genus Eriophyllum Lug. Univ. Calif. Pub. in Bot. 18:69-183.

Contor ____. In Hendee and others 1978. p. 232.

Crowe, D.C. 1976. San Joaquin Valley oxidant gradients; July-October: in workshop on photochemical oxidant monitoring in the San Joaquin Valley air basin. May 11, 1977. Fresno, California.

Dale, D.J. and T. Weaver. 1974. Trampling effects on vegetation of the trail corridors of north Rocky Mountain forests. J. Appl. Ecol. 11:767-772.

Darley, E.F., H.H. Biswell, G. Miller, and J. Gross. 1973. Air pollution from forest and agricultural burning. J. of Fire and Flammability; 4:74-81.

Daubenmire, R., and J. B. Daubenmire. 1968. Forest vegetation of eastern Washington and northern Idaho. Washington Agri. Expt. St., College of Agri., Washington St. Univ. Tech. Bull. 60. 104 p.

Davis, K. Plant/Fire Ecologist, Western Regional Office, U.S.D.I. National Park Service.

Deeming, J.E., R.E. Burgan, and J.D. Cohen. 1977. The national fire danger rating system. U.S.D.A. Forest Service Gen. Tech. Report Int. 39. Intermountain Forest and Range Exp. Stn., Ogden, Utah. 63 p.

Dixon, D. 1961. These are the champs. Amer. Forests 67:40-50.

Dixon, J.S. 1934. A study of the life history and food habits of mule deer in California: Part I - life history. Calif. Fish and Game 20(3):181-282.

Donaghey, J.L. 1969. The properties of heated soils and their relationships to giant sequoia germination and seedling growth. M.S. thesis, San Jose State Univ., San Jose, Calif. 173 p.

Downing, R.L. 1981. Deer harvest sex ratios: a symptom, a prescription, or what? Wildlf. Soc. Bull. 9(1):8-13.

Eastwood, A. 1922.

Ernst, E.F. 1949. The 1948 saddle and pack stock grazing situation in Yosemite National Park. (MS.) 77p.

__________. 1973. Preliminary report on the study of the meadows of Yosemite Valley. U.S. National Park Service, Yosemite National Park, Calif. 89 p.

Foin, T.C., Jr. ed. 1977. Visitor impacts on National Parks: the Yosemite ecological impact study. Institute of Ecology; Pub. No. 10. Univ. Calif., Davis, California. 99 p.

FS-PSW-1701-5. 1978. The ecological information base is inadequate to develop management guidelines for the maintenance and restoration of mountain meadows; problem analysis and response to managers questions. U.S.D.A. Forest Service Res. Paper. 117 p.

Gibbens, R.P., and H.F. Heady. 1964. The influence of modern man on the vegetation of Yosemite Valley. Univ. Calif. Div. of Agri. Sciences, Calif. Agri. Expt. St., Ext. Service. Manual 36. 44 p.

Graber, D.M. 1982, Ecology and management of black bears in Yosemite National Park. Final report to Nat. Park Ser. Contribution number CPSU/UCD 025/1. 206 p.

Gray, A. 1867. Proc. Amer. Acad. 7:335.

Gray, A. 1883. Contributions to North American Botany. Proc. Amer. Acad. 19:196.

Green, E.L. 1897. Flora Franciscana. p.442.

Grinnel, J. and T.I. Storer. 1924. Animal life in Yosemite. Univ. Calif. Press, Berkeley, Calif. 725 p.

Hall, H.M. and C.C. Hall. 1912. A Yosemite flora. Paul Elder, San Francisco. 262 p.

Hare, R.C. 1961. Heat effects on living plants. U.S.D.A. Forest Service. Southern Forest Exp. Stn. Occasional Paper 183. 32 p.

Harlow, D. U.S. Fish and Wildlife Service; Endangered Species Office, Sacramento, Calif.

Harms, D.R. 1975. Environmental assessment of proposed Human-Bear management program Yosemite National Park. Unpubl. NPS Document. 33 p.

__________. 1977. Black bear management in Yosemite National Park. Proc. West. Assoc. Game and Fish Comm. 12 p.

Hartesveldt, R.J. 1962. The effects of human impact upon Sequoia gigantea and its environment in the Mariposa Grove, Yosemite National Park, California. Univ. of Michigan, Ann Arbor, Michigan. Unpub. thesis. 310 p., illus.

__________. 1964. Fire ecology of the giant sequoias: controlled fire may be one solution to survival of the species. Nat. Hist. Mag. 73:12-19.

___________, H.T. Harvey, H.S. Shellhammer, and R.E. Stecker. 1975. Giant sequoias of the Sierra Nevada. U.S. Government Printing Office. Washington, D.C. 180 p.

Harvey, H.T., R.J. Hartesveldt, and J.T. Stanley. 1972. Wilderness impact study report. An interim report to the Sierra Club Outing Committee on the effects of human recreational activities on wilderness ecosystems. Sierra Club Outing Committee, San Francisco, California. 87 p.

___________, H.S. Shellhammer, and R.E. Stecker. 1980. Giant sequoia ecology; fire and reproduction. U.S. Nat. Park Service Scientific Monograph Series No. 12. 182 p.

Hastings, B.C., B.K. Gilbert and D.L. Turner. 1981. Black bear behavior and human-bear relationships in Yosemite National Park. Final report to NPS, Western Region for contract # CX-1200-9-B051. 42 p.

Heady, H. F., and P. J. Zinke. 1978. Vegetational changes in Yosemite Valley. USDI, National Park Service. Occasional Paper No. 5. 25 p.

Hecht, S.B. 1976. Human impact on subalpine ecosystems: microclimate. Vol. 2: ecological carrying capacity research for Yosemite Nat. Park; final report. Contract # CX8000-4-0026 between the Univ. Calif., Berkeley and the Nat. Park Service. 27 p.

Hendee, J.C., G.H. Stankey, and R.C. Lucas. 1978. Wilderness management. U.S.D.A. Forest Service Misc. Pub. No. 1365. 381 p.

Holmes, D.O. and H.E.M. Dodson. 1976. The effects of human trampling and urine on subalpine vegetation: a survey of past and present backcountry use and the ecological carrying capacity of wilderness, Yosemite National Park, Sierra Nevada, California. Vol. 1: ecological carrying capacity research for Yosemite Nat. Park. Contract report # CX8000-4-0026 between the Univ. Calif., Berkeley and the Nat. Park Service. 247 p.

Holmes, J.E. 1976. The seasonal and geographical distribution of indicator bacteria in subalpine and alpine waters, Yosemite National Park, Sierra Nevada, California. Vol 4: ecological carrying capacity research for Yosemite Nat. Park; final report. Contract report # CX8000-4-0026 between the Univ. Calif., Berkeley and the Nat. Park Service. 160 p.

Hood, M.V. 1965. Plant type localities, Yosemite National Park, California. Typed mss.

Horton, J.S. 1960. Vegetation types of the San Bernardino Mountains. U.S.D.A. Forest Service Tech. Paper 44. Pacific SW Forest and Range Exp. Stn. 29 p., illus.

Howell, J.T. 1961. The Tomkins-Tehipite expedition of the California Academy of Sciences. Leafl. W. Bot. 9:131-196.

__________. 19__.

Kartman, L. 1958. An insecticide - bait - box method for the control of sylvatic plague vectors. J. Hygiene 56(4):455-465.

Keay, J.A. and J.W. van Wagtendonk. 1980. Effect of backcountry use levels on incidents with black bears. Proc. of the fifth International Conf. on Bear Res. and Mgmt. Madison, Wisc. In press.

Kessell, S. R. 1975. Glacier National Park Basic Resources and Fire Ecology Systems Model: User's Manual. Gradient Modeling, Inc., West Glacier, MT. 87 p.

__________. 1976. Gradient modeling: a new approach to fire modeling and wilderness resource management. Environmental Management 1(1): 39-48.

__________. 1979a. Gradient modeling: resource and fire management (vol. 1; Springer Series on Environmental Management). Springer-Verlag, NY. 433 p.

__________. 1979b. Phytosociological inference and resource management. Environmental Management 3(1): 29-40.

Kilgore, B.M. 1973. The ecological role of fire in Sierran conifer forests. Quaternary Research 3:449-513.

__________ and D. Taylor. 1979. Fire history of a sequoia-mixed-conifer forest. Ecology 60:129-142.

Knudson, D.M. and E.B. Curry. 1981. Campers' perceptions of site deterioration and crowding. J. Forestry, Feb. pp 92-94.

Koerber, T.W. Res. Entom., Div. of For. Insect Res., PSW Forest and Range Exp. Stn., Berkeley, Calif.

Lee, R.G. 1975. The management of human components in the Yosemite National Park ecosystem. The Yosemite Institute, Yosemite, Calif. 134 p.

Leiser, A. Prof. of Environmental Horticulture. UCD, Davis, Calif.

Lemons, J. 1976. Visitor use impacts in a subalpine meadow, Yosemite National Park, California. Yosemite Nat. Park Unpub. Report. 26 p.

Leopold, A.S., T. Riney, R. McCain, and L. Tevis, Jr. 1951. The Jawbone deer herd. Calif. Div. Fish and Game Bull. 4:139 p.

__________, S.A. Cain, C.M. Cottam, I.N. Gabrielson, and T.L. Kimball. 1963. Report to the Secretary of the Interior by the Advisory Board on Wildlife Management. Sierra Club Bull. 48(3):4-11.

Lewallen, L. Vector Biology and Control Section, Vector Control Dept., State of California, Fresno.

Lewis, F.H. and M.R. Lewis. 1955.

Libby, W.J., R.F. Stettler, and F.W. Seitz. 1969. Forest genetics and forest-tree breeding. Ann. Rev. of Genetics, Vol. 3:469-493.

Longhurst, W.M., A.S. Leopold, and R.F. Dasmann. 1952. A survey of California Deer Herds, their ranges and management problems. Calif. Div. Fish and Game Bull. 6: 136 p.

Maddox, J.P., Asst. Wdlf. Mgr. - Biol., Calif. Dept. Fish and Game - Reg. 4, Fresno, Calif.

Malin, L. and A.Z. Parker. 1976. Subalpine soils and wilderness use. Vol. 3: ecological carrying capacity research for Yosemite National Park; final report. Contract report # CX8000-4-0026 between the Univ. Calif., Berkeley and the Nat. Park Service. 59 p.

McDonald, P.M. 1969. Silvical characteristics of California black oak. U.S.D.A. Forest Service Res. Paper PSW-53. Pacific SW Forest and Range Exp. Stn., Berkeley, California. 20 p.

___________. 1979. Growth of thinned and unthinned hardwood stands in the northern Sierra Nevada . . . preliminary findings in proceedings of the symposium on the ecology, management, and utilization of California oaks. U.S.D.A. Forest Service Res. Paper PSW-44. Pacific SW Forest and Range Exp. Stn., Berkeley, California. 368 p.

Meinecke, E.P. 1926. Memorandum on the effects of tourist traffic on plant life, particularly big trees, Sequoia National Park, California. Typed report to National Park Service. June 9. 19 p.

___________. 1927. Letter regarding the effects of excessive tourist travel in the Mariposa Grove, Yosemite National Park, California, to Stephen T. Mather, Director, Nat. Park Service. 4p.

Merriam, L.C., Jr., and C.K. Smith. 1974. Visitor impact on newly developed campsites in the Boundary Waters Canoe Area. J. For. 72(10):627-630.

Munz, P.A. and D.D. Keck. 1968. A California flora. Univ. Calif. Press, Berkeley, California. 1681 p.

National Park Service. 1968. Compilation of the administrative policies for the National Parks and National Monuments of scientific significance (natural area catagory). 138 p.

___________. 1978. Management policies. U.S.D.I. Nat. Park Service. 138 p.

___________. 1979. Strategy for air quality monitoring in the National Parks. Office of Air Programs, July. 38 p.

___________. 1980. Natural resources project statement for air quality in the 1980 addendum to the Joshua tree National Monument Resource Management Plan.

Nelson, B.C. Health Services Dept., State of California, Berkeley.

Olney, S.T. 1868. Proc. Amer. Acad. 7:394.

Paine, L.A. 1971. Accident hazard evaluation and control decisions on forested recreation sites. U.S.D.A. Forest Service Res. Paper PSW-68/1971.

Parmeter, J.R., Jr., Prof. of Plant Pathology, Univ. Calif., Berkeley, Berkeley, Calif.

___________ and N. J. MacGregor. 1977. A biological evaluation of Fomes annosus in Yosemite Valley. U.S.D.A. Forest Service Res. Report in manuscript form available to the public Jan. 1, 1977.

Parsons, D.J. 1976. The role of fire in natural communities: an example from the southern Sierra Nevada. Calif. Environmental Conservation. 3(2):91-99.

___________ and S.A. MacLeod. 1980. Measuring impacts of dispersed visitor use on wilderness lands. Parks 5(3):8-12.

___________, T.J. Stohlgren, and P.A. Fodor. 1981. Establishing backcountry use quotas: an example from Mineral King, California. Nat. Park Service, Sequoia and Kings Canyon National Parks. (In press).

Pfister, R. D., B. L. Kovalchik, S. F. Arno, and R. C. Presby. 1977. Forest habitat types of Montana. USDA Forest Service, Int. For. & Rng. Exp. St. General Technical Report INT-34. 174 p.

Powell, W.R. 1980. Inventory of rare and endangered vascular plants of California. California Native Plant Soc., Spec. Pub. 1. (2nd edition). 115 p.

Presnall, C.C. 1933. Fire studies in the Mariposa Grove. Yosemite Nature Notes 12:23-24.

Recreational Impacts on Wildlands. 1979. Conference proceedings on recreational impacts on wildlands, Oct. 27-29, 1978, Seattle, Washington. U.S. Forest Service, Pacific NW Region. 341 p.

Riegelhuth, D. and G. Tanaka. 1979. A synopsis of the black bear in Yosemite National Park. USDI Nat. Park Serv. Unpubl. Doc. 2 p.

Rundel, P.W. 1972. Habitat restriction in giant sequoia: the environmental control of grove boundaries. Amer. Mdl. Nat. 87(1):81-99.

Rydberg, P.A. 1932. N. Amer. Fl. 21:328.

Sano, J. and A. Moad. 1978. Stock use in the Yosemite backcountry; Yosemite Nature Notes 47(3):22-25.

Schempf, P.F. and M. White. 1974. A survey of the status of seven species of carnivores on National Park Service lands in California. Final Report to the U.S. Nat. Park Service under contract number: CX 8000-3-0025. 129 p.

____________. 1977. Status of six furbearer populations in the mountains of northern California. Published by U.S.D.A. Forest Service, California Region. 51 p.

Sessa, R. Public health Services, Fresno County, Fresno, California.

Sharsmith, C.W. 1961. A report on the status, changes, and comparative ecology of selected backcountry meadow areas in Yosemite National Park that receive heavy visitor use. Unpub. Nat. Park Service Report. 58 p.

Show, S.B. and E.I. Kotok. 1924. The role of fire in the California pine forests. U.S.D.A. Bulletin, 1294. 80 p.

Smiley, F.J. 1921. A report on the boreal flora of the Sierra Nevada of California. Univ. Calif. Pub. Bot. 9. 423 p.

Smithsonian Institution. 1975. Report on endangered and threatened plant species of the United States. Serial No. 91-A, U.S. Government Printing Office, Washington.

Snyder, J.B. Park Trail Foreman, Yosemite National Park, Calif.

____________. 1978. Trail erosion in mountain meadows. Yosemite Nature Notes 47(3):26-30.

Society of American Foresters. 1954. Forest cover types of North America. Washington, D.C. 67 p., illus.

Stanley, J.T., Jr.(ed.), H.T. Harvey, and R.J. Hartesveldt. 1977. A report on the wilderness impact study. Sierra Club Outing Committee. 290 p.

Stebbins, G.L. 1978. "Why are there so many rare plants in California? Part II. Youth and age of species." Fremontia 6(1):17-20.

Stevens, C. Horticulturalist, Yosemite Park and Curry Co. Yosemite National Park, Calif.

Stock Use Plan. 1980. Unpubl. plan for the use of stock in Yosemite National Park, Calif. Yosemite, California. 11 p.

Sumner, L. and R.M. Leonard. 1947. Protecting mountain meadows. Sierra Club Bulletin 32(5):53-62.

Swift, W.S. 1975. An investigation of the seedling pathology of giant sequoia. M.S. thesis, San Jose State Univ., San Jose, Calif. 44 p.

Tappeiner, J. and P.M. McDonald. 1979. Preliminary recommendations for managing California black oak in the Sierra Nevada. In proceedings of the symposium on the ecology, management, and utilization of California oaks. U.S.D.A. Forest Service Res. Paper PSW-44. Pacific SW Forest and Range Exp. Stn., Berkeley, California. 368 p.

Taylor, D.D. 1969. Report on black oak study plots. Memorandum to files, Yosemite Nat. Park, Yosemite, California. Oct. 22. 9 p.

U.S. Fish and Wildlife Service. 1980. Draft federal register notice review--list of candidate endangered, threatened, and possibly extinct species of plants for California. Prepared by the Sacramento Endangered Species Office.

____________. 1980. Notice of review, endangered and threatened wildlife and plants: review of plant taxa for listing as endangered or threatened species. Federal Register, Park IV, Dec. 15, 1980.

U.S. Government Printing Office 1977. The clean air act as amended August 1977, Serial No. 95-11. 95th Congress, 1st session. Sec. 165, 169A (a)(1).

van Riper III, C. 1981. Letter regarding control of bull thistle and common mullein in Yosemite National Park, California, to Jan van Wagtendonk, Research Scientist, Yosemite National Park. 2 p.

van Wagtendonk, J.W. Park Research Scientist, Yosemite National Park, California.

____________. 1981. The effects of use limits on backcountry visitation trends in Yosemite National Park. U.S. Nat. Park Service, Yosemite, California. 23 p.

____________. 1979. Visitation trends in the Yosemite backcountry. Nat. Park Service Report, Yosemite, California. 6 p.

____________. 1979. Interim 1978 NFDRS burning prescriptions. Research Office, Yosemite Nat. Park, Calif.

____________ and J.M. Benedict. 1980. Wilderness permit compliance and validity. J. Forestry 78(8):399-401.

Vankat, J. L., and J. Major. 1978. Vegetation changes in Sequoia National Park, CA. Journal of Biogeography 5: 377-402.

Wagener, W.W. 1961. Past fire incidence in Sierra Nevada forests. J. Forestry 59(9):739-747.

Walton, B. Santa Cruz Predatory Bird Research Group, Univ. Calif., Santa Cruz, Calif.

Ward, D.E. and R.C. Lamb. 1970. Prescribed burning and air quality. Current research in the south from proceedings of the 10th Tall Timbers fire ecology conference. Tall Timbers Res. Stn., Tallahassee, Florida. pp. 129-149.

Ward, G.H. 1953. Contr. Dudley Herb. 4:192.

Waring, R.H. 1969. Forest plants of the eastern Siskiyous: their environmental and vegetational distribution. Northwest Science 43:1-17, illus.

Weaver, H. 1976. Fire and its relationship to ponderosa pine. In proceedings of the Tall Timbers fire ecology conference. 7:127-149.

Weaver T. and D. Dale. 1977. Trampling effects of hikers, motorcycles, or horses in meadows and forests. J. Appl. Ecol. (In press).

Wehausen, J.D. 1980. Sierra Nevada bighorn sheep: history and population ecology. Final report to NPS. 240 p.

__________. 1981. Personal Communication.

Winter, J. 1980. Some aspects of the ecology of the great gray owl in the central Sierra Nevada. Final Report to U.S.D.A. Forest Service, Stanislaus National Forest. Contract #43-2276. 22 p.

Wittreich, C.D. and E.O. Garton. 1979. A preliminary study of peregrine falcons in Yosemite National Park. Univ. of Idaho, Moscow, Idaho.

Wood, S.H. 1975. Holocene stratigraphy and chronology of mountain meadows, Sierra Nevada, California. Ph.D. dissertation; California Institute of Technology, Pasadena, California. 180 p., illus.

Workman, G.W. and J.B. Low. (eds.). 1976. Mule deer decline in the west: A symposium. Utah State University, Logan, Utah. 134 p.

Yosemite National Park 1981. Environmental assessment for the biological control of Klamath weed with Chrysolina beetles in Yosemite National Park. Yosemite, California. 3 p.

Ziegler, R. L., and H. F. Heady. 1964. Vegetational types in relation to soil in Yosemite Valley. Unpublished progress report to the USDI Nat. Park Serv., West. Reg. Off., San Fran, CA. 49 p.

___________. 1965. Woody vegetation in relation to soil in Yosemite Valley. Unpublished progress report to the USDI Nat. Park Serv., West. Reg. Off., San Fran., CA. 38 p.

Zinke, P. J., and E. Alexander. 1963. The soil and vegetation of Yosemite Valley. Unpublished progress report to the USDI Nat. Park Serv., Reg. Off., San Francisco, CA. 86 p.

NATURAL RESOURCES PROJECT PROGRAMMING SHEET

Yosemite National Park, California - Western Region

March 31, 198

INC. NO.	PKG. NO.	PARK PRIORITY	PLAN PRIORITY	REF. NO.	PROJECT TITLE	ACTION TYPE	YEAR 1 NPS	COST/ W.Y.$1000	YEAR 2 NPS	COST/ W.Y.$1000	YEAR 3 NPS	COST/ W.Y.$1000	YEAR 4 NPS	COST/ W.Y.$1000	YEAR NPS	CO W.Y.$1
On-going; No ONPS Funds Requested																
--	--	--	--	N19	Vector Control	Mgmt.	No funds requested until completion of a management pla									
--	--	--	--	N22	Fisheries Management	Mgmt.	" " " " " " " " "									
--	--	--	--	N24	Snow Surveys	Monitor.	No funds requested. All funding provided by the State California.									
--	--	--	--	N31	Water Quality Monitoring	Monitor.	Funded at the initial level. No additional funds requested at this time.									
On-going Program; Some ONPS Funding Requested																
388	--	12	1	N28	Peregrine Falcon Management	Mgmt. & Monitor.	0.4	26.5	0.4	26.5	0.4	26.5	0.4	26.5	0.4	2
389	--	13	2	N27	Wilderness Impact Monitoring	Monitor.	2.1	36.0	2.1	36.0	2.1	36.0	2.1	36.0	2.1	3
477	--	59	3	N17	Deer Herd & Range Research & Monitoring	Res. & Monitor.	1.3	35.0	1.3	35.0	1.3	35.0	--	--	--	
398 479	--	16	4	N9	Hazard Tree Removal	Mgmt.	2.9	153.0	2.9	63.9	2.9	63.9	2.9	63.9	2.9	6
453	--	49	5	N1 N2	Prescribed Burning Prescribed Natural Fire Management	Mgmt. Mgmt.	3.5	67.6	3.5	67.6	3.5	67.6	3.5	67.6	3.5	6

NATURAL RESOURCE PROJECT PROGRAMMING SHEET

Yosemite National Park, California - Western Region

INC. NO.	PKG. NO.	PARK PRIORITY	PLAN PRIORITY	REF. NO.	PROJECT TITLE	ACTION TYPE	YEAR 1 NPS W.Y.	YEAR 1 COST/ $1000	YEAR 2 NPS W.Y.	YEAR 2 COST/ $1000	YEAR 3 NPS W.Y.	YEAR 3 COST/ $1000	YEAR 4 NPS W.Y.	YEAR 4 COST/ $1000	YEAR 5 NPS W.Y.	YEAR 5 COST/ $1000
--	461	14	6	N15	Black Bear Management	Mgmt.		129.5		--		--		--		--
447	--	50	7	N25	Air Quality Monitoring	Monitor.	0.4	207.5	0.4	55.2	0.4	55.2	0.4	55.2	0.4	55.2
391	--	18	8	N8	Exotic Plant Control	Res. & Mgmt.	0.3	24.6	0.3	24.6	0.3	24.6	0.3	4.6	0.3	4.6
254	--	51	9	N10	Plant Propagation & Revegetation	Mgmt.	0.5	19.0	0.5	19.0	0.5	19.0	0.5	19.0	0.5	19.0
448	--	52	10	N26	Threatened & Endangered Plant Management	Mgmt.	0.8	12.0	0.8	12.0	0.8	12.0	0.8	12.0	0.8	12.0
48 80	--	15	11	N3	Wildland Fire Control	Mgmt.		166.5		166.5		166.5		166.5		166.5
390	--	55	12	N32	Vegetation Analysis System	Res.	2.8	66.6	2.8	66.6	2.8	66.6	2.8	66.6	2.8	66.6
449	--	55	13	N6	Meadow Restoration by Trail Reconstruction	Mgmt.	3.5	77.0	3.5	77.0	3.5	77.0	3.5	77.0	3.5	77.0

NATURAL RESOURCES PROJECT PROGRAMMING SHEET

Yosemite National Park, California - Western Region

March 31, 1982

INC. NO.	PKG. NO.	PARK PRIORITY	PLAN PRIORITY	REF. NO.	PROJECT TITLE	ACTION TYPE	YEAR 1 NPS COST/ W.Y.$1000	YEAR 2 NPS COST/ W.Y.$1000	YEAR 3 NPS COST/ W.Y.$1000	YEAR 4 NPS COST/ W.Y.$1000	YEAR 5 NPS COST/ W.Y.$1000
450	--	59	14	N5	Black Oak Woodland Restoration	Mgmt. & Res.	0.6 35.5	0.6 35.5	0.6 35.5	0.6 15.5	0.6 15.5
451	--	60	15	N4	Giant Sequoia Grove Restoration	Mgmt. & Res.	0.7 35.5	0.7 35.5	0.7 35.5	0.7 15.5	0.7 15.5
452	--	96	16	N7	Grazing	Monitor.	1.0 15.6	1.0 15.6	1.0 15.6	1.0 15.6	1.0 15.6
Pending; No ONPS Funding Requested At This Time											
--	--	--	17	N18	Reintroduction of Bighorn Sheep	Mgmt. Res. & Monitor.	No funds requested until completion of U.S.F.S. research project.				
--	--	--	18	N30	Great Gray Owl Management	Mgmt. & Monitor.	No funds requested until completion of a management plan.				
--	--	--	19	N13	Forest Insect & Disease Monitoring	Monitor.	" "	" "	"	" "	" "
--	--	--	20	N29	Wolverine Monitoring	Monitor.	" "	" "	"	" "	" "