



## **Chapter 4**

Environmental  
Consequences

**ON THE PREVIOUS PAGE**

Oak woodlands and chaparral in the foothills

Photo Courtesy of Tim Williams

## **CHAPTER 4: ENVIRONMENTAL CONSEQUENCES**

This chapter describes the potential environmental consequences of implementing any of the alternatives being considered. It is organized by resource topic and provides a standardized comparison between alternatives based on impact topics discussed in chapters 1 and 3. Direct, indirect, and cumulative impacts are described, and significance of the impacts is assessed in terms of context, intensity, and duration (in accordance with Council on Environmental Quality (CEQ) regulations 40 CFR § 1502.16).

This analysis is based on the assumption that the mitigation measures identified in “Mitigation Common to All Alternatives” (in chapter 2) would be implemented for the action. Mitigations are actions taken to lessen the severity and probability of a potential impact. The analysis for each impact topic includes the methods used to assess the type of impact. As required by the CEQ regulations implementing NEPA, a summary of the environmental consequences for each alternative is provided in table 53 on page 257 at the end of chapter 2. Because this document addresses compliance with Section 106 of the National Historic Preservation Act of 1966 (NHPA), the analysis of cultural resources also contains an assessment of effect. Integration of the requirements of Section 106 of the NHPA into the NEPA process and documentation are accomplished by meeting the criteria set forth in 36 CFR § 800.8(c)(1)-(4). The information required by the criteria set forth in 36 CFR § 800.8(c)(1)(ii)-(v) is incorporated into the analysis in this chapter.

### **GENERAL METHODOLOGY FOR ANALYZING IMPACTS**

#### **GENERAL ANALYSIS METHODS**

The NPS based these impact analyses and conclusions on a review of existing literature, studies, and research done by the parks, information provided by experts within the parks and other agencies and institutions, professional judgment, staff expertise and insights, and public input. These analyses relied most heavily on existing literature and studies conducted specifically to support this plan. The following is a description of the geographic area evaluated for the impacts, and the definition for the common terms used within this chapter to assess the impacts of each alternative on each impact topic.

#### **GEOGRAPHIC AREA EVALUATED FOR IMPACTS**

Sequoia and Kings Canyon National Parks are located in Central California between the Owens Valley and the San Joaquin Valley. The two parks occupy the western slope of the Sierra Nevada, the 400-mile-long mountain range that forms the eastern edge of the California biological and cultural province. Combined acreage for the two parks is 865,964 acres. The parks span a great range of elevation; Sequoia National Park rises from the low western foothills at 1,370 feet in elevation to the crest of the Sierra Nevada at 14,494 feet high Mount Whitney, the highest point in the lower 48 states.

The WSP/DEIS is evaluating the wilderness areas within the parks, including designated potential wilderness areas (DPWA) and proposed wilderness areas managed as wilderness. Together, these encompass nearly 97% of the parks’ area. Where appropriate, adjacent frontcountry areas are also evaluated. Some actions are taken in the frontcountry for the management of wilderness, which could impact resources in wilderness areas.

**DURATION AND TYPE OF IMPACTS**

Impacts are discussed by type, as follows (the terms “impact” and “effect” are used interchangeably throughout this document):

**Beneficial:** An impact that would result in a positive change to the resource when compared to the existing conditions.

**Adverse:** An impact that causes an unfavorable result to the resource when compared to the existing conditions.

**Direct:** Impacts that would occur as a result of the proposed action at the same time and place of implementation (40 CFR § 1508.8).

**Indirect:** Impacts that would occur as a result of the proposed action but later in time or farther in distance from the action (40 CFR § 1508.8).

**CUMULATIVE EFFECTS ANALYSIS METHOD**

A cumulative effect is defined as “the impact on the environment that results from the incremental impact of the action when added to other past, present, or reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions” (40 CFR 1508.7). As stated in the CEQ handbook, *Considering Cumulative Effects under the National Environmental Policy Act* (CEQ handbook 1997), cumulative effects need to be analyzed in terms of the specific resource, ecosystem, and human community being affected, and should focus on impacts that are truly meaningful.

Cumulative effects are considered for all alternatives. Cumulative effects were determined for each affected resource by combining the impacts of the alternative being analyzed and other past, present, and reasonably foreseeable actions that would also result in beneficial or adverse impacts. Because some of these actions are in the early planning stages, evaluation of the cumulative effect is based on a general description of the projects. These actions were identified through the internal and external project scoping processes.

**Table 74: Past, Current, and Future Actions that Make Up the Cumulative Effects Scenario**

<b>Action or Project</b>	<b>Status</b>	<b>Brief Description</b>	<b>Impact Topics</b>
Bear Management Plan	Past, ongoing, and future	Activities under the Bear Management Plan generally occur in the frontcountry but affect bears that use wilderness areas. Some of these activities (e.g., hazing, capturing and tagging, euthanasia) would adversely impact individual animals in the short-term but would not likely have population-level effects, while other bear-management activities (e.g., visitor education, food-storage regulation, law enforcement, etc.) would beneficially impact individuals as well as provide a population-level benefit, in both the short and long term.	- Wilderness Character - Wildlife: Bears

**Table 74: Past, Current, and Future Actions that Make Up the Cumulative Effects Scenario (continued)**

Action or Project	Status	Brief Description	Impact Topics
Research activities permitted through Sequoia and Kings Canyon National Parks	Past, ongoing, and future	Over the past three years, 73% of the parks' permitted research included activities in wilderness. Research may include, but is not limited to inventory, monitoring, and studies, surveys, and assessments on biodiversity, genetic differentiation and taxonomic, species distribution, glaciology, geology, mineralogy, geologic mapping, water quality and quantity, air quality, wetlands, habitat associations and modeling, population demographics, home-range and movement, mark/recapture, nonnative species impacts, ecosystem effects of airborne or aquatic contaminants, climate change, fire history and ecology, species and ecosystem restoration techniques, and ecology.	- Wilderness Character
Soils Mapping Project	Past, ongoing through 2016	This project is a collaboration between these parks, the NPS Geologic Resources Division and the State of California Natural Resource Conservation Service. Soils mapping will entail teams of four to five technicians examining surface soils across the parks' wilderness and remote-sensing data analysis; some ground disturbance will occur during soil assessment. Final project work will include a comprehensive soil map with extensive data analysis concerning physical soil characteristics (hydrology, chemistry, etc.), plant and ecological community associations, and much more.	- Wilderness Character - Soils
High-elevation Forest Monitoring Program	Past, ongoing, and future	The objectives of this long-term project are to quantify the present conditions of high-elevation forests in Sierra Nevada parks (Yosemite, Sequoia, and Kings Canyon national parks and Devils Postpile National Monument), and determine whether these conditions are changing over time in a manner that will warrant management action.	- Wilderness Character
Lake Sampling Project	Past, ongoing, and future	The Sierra Nevada Inventory and Monitoring Network, in conjunction with the Division of Resources Management and Science in these parks, have implemented a long-term park-wide program to monitor lake ecosystems (since 2007). This project assesses lake ecosystem status and trends. There are 49 lakes in wilderness selected for long-term monitoring.	- Wilderness Character

**Table 74: Past, Current, and Future Actions that Make Up the Cumulative Effects Scenario (continued)**

Action or Project	Status	Brief Description	Impact Topics
Wetland Monitoring	Ongoing and future	The Sierra Nevada Inventory and Monitoring Network is preparing to implement a long-term park-wide program to monitor wetland ecological integrity. This project is designed to provide basic information on the condition of targeted wetlands (wet meadows and fens), and to allow for the evaluation of long-term trends of key ecological variables in Sierra Nevada parks. Wetlands monitoring will begin in summer 2014 and will include hydrologic (groundwater wells), vegetation, and invertebrate monitoring at 30 sites in Sequoia and Kings Canyon.	- Wilderness character - Vegetation: Wetlands and meadows
Air Quality Monitoring	Past, ongoing, and future	Remote Automated Weather Stations provide critical weather data for developing fire behavior predictions in wilderness areas. Two RAWs are currently placed in the parks' wilderness each summer, and are the primary resources for monitoring air quality associated with fire.	- Wilderness character
Snow Surveys	Past, ongoing, and future	The California Division of Water Resources has over 30 sites in the parks' wilderness as part of their data-collection network. The California Division of Water Resources has collected snowpack and other climatic data and conducted ongoing studies (in cooperation with the NPS) for more than 50 years at a large majority of these sites.	- Wilderness character
Bighorn Sheep Restoration Plan and U.S. Fish and Wildlife Service (USFWS) Bighorn Sheep Recovery Actions	Past, ongoing, and future	This project involves collaring, monitoring, and reintroducing bighorn sheep into wilderness in partnership with the California Department of Fish and Wildlife, both in NPS and adjacent U.S. Forest Service (USFS) (Inyo) wilderness areas.	- Wilderness character - Special-status species
Aquatics Restoration Plan  Habitat/Ecosystem Restoration Projects	Past, ongoing, and future	The NPS in Yosemite, Sequoia and Kings Canyon national parks have on-going habitat-restoration programs that include eradication of nonnative fish in wilderness. Thus far Sequoia and Kings Canyon have restored or are restoring 26 lakes by eradicating nonnative trout (Vredenburg 2004, NPS 2012c). Yosemite has restored or is in the process of restoring eight lakes. If the program is approved for expansion, these activities will continue to occur for the next 30 years within the parks' wilderness.	- Wilderness character - Water resources - Special-status species

**Table 74: Past, Current, and Future Actions that Make Up the Cumulative Effects Scenario (continued)**

Action or Project	Status	Brief Description	Impact Topics
Related studies on frogs	Past, ongoing, and future	Intensive field studies on mountain yellow-legged frogs, in the parks and on neighboring USFS lands, include but are not limited to efforts to better understand the effects of nonnative fish, chytrid fungus, pollution and climate change, and how to mitigate those effects. Much of this work is in wilderness. Actions performed include marking animals for tracking purposes, removing a small percentage of animals from a population for disease studies in the lab and the field, collecting tissue for genetic analyses, and treating animals with antifungal cleansers and probiotics. Reintroduction of frogs into unoccupied habitat is also ongoing.	- Wilderness character - Special-status species
Yosemite toad activities	Past, ongoing, and future	Several studies are taking place within the range of the Yosemite toad in wilderness. Projects in the parks involve: 1) documenting current distribution; 2) relating Yosemite toad population trends to ongoing visitor uses of toad meadow habitat; 3) relating habitat suitability/condition to toad distributions and historical visitor stock-use patterns; 4) providing detailed, credible information for analysis and management recommendations, and 5) developing best management practices for traditional wilderness visitor use activities to protect toad habitat and preserve visitor opportunities. These studies are observational and not likely to have an effect on the Yosemite toad, other than increasing knowledge about the species.	- Wilderness character - Special-status species
Cave Management Plan	Past, ongoing, and future	Ongoing cave management is based on the 1998 Cave Management Plan, which provides for administering and protecting cave resources in the parks. An updated Cave and Karst Management Plan is in preparation and would create a planning framework providing essential information to managers, and define cave and karst management activities.	- Wilderness character
Halstead Meadow Restoration	Past, ongoing, and future	This ongoing project was initiated in 2007; its final phase will likely start in 2017. Halstead Meadow, a portion of which is in wilderness, is the most severely damaged meadow in Sequoia National Park. The project includes restoring the meadow landforms, hydrologic processes, wetlands vegetation, and functions.	- Wilderness character - Soils - Water resources - Vegetation: Wetlands and meadows - Wildlife



**Table 74: Past, Current, and Future Actions that Make Up the Cumulative Effects Scenario (continued)**

Action or Project	Status	Brief Description	Impact Topics
Cahoon Meadow Restoration	Future	Cahoon Meadow, 17 acres, lies at 7,350 feet elevation at the headwaters of Cahoon Creek, a tributary of the East Fork of the Kaweah River in the John Krebs Wilderness. In private ownership until 1977, the meadow was historically dedicated to cattle grazing. During this time, the stream channel was severely impacted by cattle, marking the onset of serious erosion. Upon acquisition by the NPS, grazing was discontinued. For the past 30 years the channel has continued to show active head erosion, which produced a massive gully extending over 75% of the length of the meadow. The gully has lowered the water table and reduced the meadow's water-storage capacity. Planning is underway to restore the meadow.	<ul style="list-style-type: none"> <li>- Wilderness character</li> <li>- Soils</li> <li>- Water resources</li> <li>- Vegetation: Wetlands and meadows</li> <li>- Wildlife</li> </ul>
Invasive Species Management Plan/Activities	Past, ongoing, and future	This project includes control, survey, and monitoring of exotic vegetation, follow-up treatment, preventive measures, and data management using park-approved methods.	<ul style="list-style-type: none"> <li>- Wilderness character</li> <li>- Vegetation</li> <li>- Visitor use</li> </ul>
Ecological Restoration Program	Past, ongoing, and future	This program restores landscapes disturbed by human impacts or development to more natural conditions. Abandoned non-historic human development may be removed (asphalt, marijuana grow-site materials, etc.); disturbed landforms recontoured close to their pre-disturbance state to restore natural drainage patterns; and erosion-control measures installed. The projects in wilderness are marijuana grow-site, wilderness trail, and campsite restoration.	<ul style="list-style-type: none"> <li>- Wilderness character</li> <li>- Soils</li> <li>- Water resources</li> <li>- Vegetation</li> <li>- Wildlife</li> </ul>
Fire Management	Past, ongoing, and future	The Fire and Fuels Management Plan, completed in 2003, directs management of fires in these parks. The plan supports the use of prescribed fires, allowing fires to burn, suppression where necessary, and follow-up restoration actions. The goals of fire use are to restore and maintain ecosystems, reduce hazard fuels, protect natural and cultural resources, and protect wildland / urban-interface communities.	<ul style="list-style-type: none"> <li>- Wilderness character</li> <li>- Soils</li> <li>- Vegetation</li> <li>- Wildlife: bears</li> <li>- Cultural resources</li> <li>- Visitor use</li> </ul>
Concessions Prospectus	Future	The Sequoia National Park concessions prospectus will be renewed in 2014–2015. Whether the Bearpaw Meadow High Sierra Camp will be authorized to operate in the future is directly linked to this WSP.	<ul style="list-style-type: none"> <li>- Wilderness character</li> <li>- Visitor use</li> <li>- Park operations</li> </ul>



**Table 74: Past, Current, and Future Actions that Make Up the Cumulative Effects Scenario (continued)**

Action or Project	Status	Brief Description	Impact Topics
Parkwide Communication Network	Past, ongoing, and future	The parks' radio system consists of 17 repeaters, 15 base stations, and 10 towers. Two of the equipment sites are in developed areas reachable by road. Radio-repeater maintenance includes troubleshooting and basic repair work. System maintenance includes routine replacement of antennas, transmission lines, solar panels, batteries, lightning protection, and underground cables. On-ground maintenance and repair work includes the use of non-motorized and battery-operated hand tools.	- Wilderness character - Park operations
Existing Rights-of-Way, Dams, and related structures	Past, ongoing, future	Rights-of-way for two utility-powerline corridors are authorized in potential wilderness per the California Wilderness Act of 1984, Sec 101 (24): 1) a 60-foot-wide corridor running from Moro Rock's summit benchmark to near the Middle Fork Road, and 2) a 60-foot-wide corridor on the west side of Kings Canyon National Park from near Lookout Peak to the Cedar Grove vicinity (approximately 12 and 22 acres, respectively). There are four constructed dams in wilderness. Their purpose is to hold and regulate water runoff for electrical-power generation. The powerlines and dams receive periodic maintenance.	- Wilderness character
Lodgepole, Wolverton, and Wuksachi Management Plan	Future	A comprehensive visitor-service and facilities plan is being developed with the overall purpose of improving visitor and administrative services and functions at the Lodgepole, Wolverton, and Wuksachi areas within Sequoia National Park, while ensuring protection of natural and cultural resources. This project could affect wilderness access.	- Visitor use
Mineral King Management Plan	Future implementation plan	This comprehensive planning effort will determine what frontcountry facilities are necessary at Atwell Mill and Mineral King. It could include changing parking-lot configurations, trailhead parking/signage, access-road improvements, and maintenance activities. This project could affect wilderness access.	- Visitor use
Generals Highway Project	Past, ongoing, and future	The NPS, in cooperation with Central Federal Lands Highway Division of the Federal Highway Administration, will be resurfacing, restoring, and rehabilitating 7 miles of Generals Highway between Deer Ridge and Wolverton Road and the 1.3-mile Wolverton Road to the trailhead parking lot. This project could affect wilderness access.	- Visitor use
Sequoia National Park Transit System	Past, ongoing, and future	The existing transit system in Sequoia National Park allows for improved opportunities for trailhead access and parking at Crescent Meadow and Wolverton.	- Visitor use

**Table 74: Past, Current, and Future Actions that Make Up the Cumulative Effects Scenario (continued)**

Action or Project	Status	Brief Description	Impact Topics
USFS – Land management plans for Sierra, Inyo, and Sequoia national forests and Giant Sequoia National Monument	Past, ongoing, and future	Management plans that could affect visitor use within the parks' wilderness, or in the region, are the USFS wilderness plans for the John Muir, Golden Trout, and Monarch wilderness areas, and the USFS forest plan amendments for the Sierra, Inyo, and Sequoia national forests and Giant Sequoia National Monument (wilderness areas adjacent to these parks). The USFS wilderness plans established restrictions on visitor use, including trailhead quota limits, caps on commercial services, and exit quota limits on Mount Whitney. The ongoing planning efforts would include a recreational-use component in order to balance resource-protection mandates with visitor enjoyment. These plans would enhance visitor experience through preservation of natural conditions, while affecting some visitor activities through the implementation of additional restrictions or regulations. Since many wilderness visitors in Sequoia and Kings Canyon National Parks access wilderness from adjacent USFS-managed areas, these management plans have the potential to affect wilderness use within the parks.	<ul style="list-style-type: none"> <li>- Wildlife: bears</li> <li>- Visitor use</li> <li>- Fire management</li> <li>- Vegetation: nonnative plants</li> </ul>
Bear hunting activities outside park boundaries	Past, ongoing, and future	Bear hunting would adversely impact individual bears that are harvested but there would be no long-term population-level impacts, because harvest rates are maintained at a conservative level.	<ul style="list-style-type: none"> <li>- Wildlife: bears</li> </ul>
Golden Trout Recovery Program	Past, ongoing, and future	The California Department of Fish and Wildlife (CDFW), USFS, USFWS, and NPS are cooperating to recover Little Kern golden trout (federally threatened), California golden trout, and Kern rainbow trout within their historical ranges. Efforts to reverse the decline of these species include improving habitat via eradication of nonnative fish that have the capacity to hybridize with native stocks; restocking with genetically pure fish; restoring damaged critical habitat; and protecting native stocks from habitat deterioration and excessive angler harvest.	<ul style="list-style-type: none"> <li>- Wilderness character</li> <li>- Special-status species</li> <li>- Visitor use</li> </ul>
Yosemite National Park Wilderness Stewardship Plan	Future	The NPS will update the 1989 Yosemite Wilderness Management Plan starting in 2015. The objective is to provide guidance to park operations for the successful management of Yosemite's designated wilderness, which comprises over 95% of the park. This planning effort relates to wilderness use at Sequoia and Kings Canyon National Parks because many park visitors begin their wilderness trips on the John Muir Trail in Yosemite.	<ul style="list-style-type: none"> <li>- Cultural resources</li> <li>- Visitor use</li> </ul>

## **ASSESSING IMPACTS USING CEQ CONSIDERATIONS**

The impacts of the alternatives are assessed using the CEQ definition of the word “significantly” (1508.27), which requires consideration of both context and intensity of impacts:

- a) Context – This means that the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the effects in the locale rather than in the world as a whole. Both short-term and long-term effects are relevant.
- b) Intensity – This refers to the severity of impact. Responsible officials must bear in mind that more than one agency may make decisions about partial aspects of a major action. The following should be considered in evaluating intensity:
  - 1) Impacts that may be both beneficial and adverse. A significant effect may exist even if the federal agency believes that on balance the effect would be beneficial.
  - 2) The degree to which the proposed action affects public health or safety.
  - 3) Unique characteristics of the geographic area such as proximity to historic or cultural resources, parklands, prime farmlands, wetland, wild and scenic rivers, or ecologically critical areas.
  - 4) The degree to which the effects on the quality of the human environment are likely to be highly controversial.
  - 5) The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.
  - 6) The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.
  - 7) Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.
  - 8) The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places (National Register) or may cause loss or destruction of significant scientific, cultural, or historical resources.
  - 9) The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973.
  - 10) Whether the action threatens a violation of federal, state, or local laws or requirements imposed for the protection of the environment.

For each impact topic analyzed, an assessment of the potential significance of the impacts according to context and intensity is provided in the “Conclusion” section that follows the discussion of the impacts. Context includes both overall context and resource-specific context. Overall context is presented here in the “General Methodology for Analyzing Impacts” section because it is based on the purpose and significance of the two national park units and applies across all resource topics. Resource-specific context is presented in the “Methodologies for Analyzing Impacts” section under each resource topic, as applicable, and applies across all alternatives. Intensity of the impacts is presented using the applicable

factors from the list in (b) above. Intensity factors that do not apply to a given resource topic and/or alternative are not discussed.

## **WILDERNESS CHARACTER**

In this section, impacts on wilderness character are assessed. The analysis includes an evaluation of the potential for the qualities that comprise wilderness character to be altered by each alternative.



Photo Courtesy of Isaac Chellman

**Natural, undeveloped, untrammeled: solitude and primitive recreation at Sixty Lake Basin.**

## **METHODOLOGY FOR ANALYZING IMPACTS**

NPS wilderness-management policies are based on provisions of the 1916 NPS Organic Act, the 1964 Wilderness Act, NPS policies and Director’s Orders, and legislation establishing individual units of the national park system. In accordance with the Wilderness Act, wilderness areas “shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness....” Section 2(c) of the Wilderness Act defines wilderness as “an area untrammeled by man; an area of undeveloped land that retains its primeval character and influence; an area protected and managed to preserve its natural conditions; and, which has outstanding opportunities for solitude or a primitive and unconfined type of recreation.”

To define the baseline conditions of wilderness character for Sequoia and Kings Canyon National Parks, the parks’ staff developed a Wilderness Character Assessment to describe what is unique and special about the parks’ wilderness areas and provide a description of the current state of the wilderness. In addition to describing the special characteristics of the parks’ wilderness, the assessment identifies actions or conditions that are or could impact wilderness character. Information for the assessment was derived from surveys, interviews, and a workshop with current and former park employees who have extensive

experience in and with the parks' wilderness. It also considers and incorporates public comments from scoping sessions from this wilderness planning effort (Frenzel and Fauth 2014). Alternatives are evaluated against this baseline to determine the changes that would occur to each quality under each alternative.

## **TYPES OF IMPACTS ON WILDERNESS CHARACTER**

**Untrammeled:** An untrammeled wilderness is one in which ecological systems and their biological and physical components are autonomous, free from human intervention. By contrast, human actions that restrict, manipulate, or attempt to control the natural world within wilderness degrade the untrammeled quality. Trammeling actions include the removal of nonnative species, intervention in the behavior or lives of native plants and animals, projects to restore the natural conditions of wilderness, and interference in natural processes and energy flows. These actions may be temporary but, while they are in effect, they affect the untrammeled quality of wilderness. Unauthorized trammeling, such as modifying areas for illegal marijuana cultivation, may also affect wilderness character.

**Natural:** An undegraded natural wilderness quality shows minimal effects of modern civilization upon the ecological systems and their biological and physical components. A natural wilderness comprises landforms, soils, waterways, habitats, species, and terrestrial food webs that are largely intact in their natural state and not influenced by human activities and external threats.

**Undeveloped:** The Wilderness Act states that wilderness is “an area of undeveloped federal land retaining its primeval character and influence, without permanent improvements or human habitation,” with “the imprint of man’s work substantially unnoticeable.” The undeveloped quality of wilderness is impacted by the presence of structures and installations, and by the use of motor vehicles or motorized equipment. These developments are also prohibited by Section 4 (c) of the Wilderness Act, and are only permissible if they are “necessary to meet minimum requirements for the administration of the area” as wilderness.

**Opportunities for Solitude or Primitive and Unconfined Recreation:** The Wilderness Act states in Section 2(c) that wilderness has “outstanding opportunities for solitude or a primitive and unconfined type of recreation.” Opportunities for solitude or primitive and unconfined recreation provide visitors a chance to connect with the natural world, to practice traditional skills, and to have transformative personal experiences. Opportunities for solitude can be affected by encounters with other visitors, and changes in management that alter visitor recreation behavior. Developments that support public recreation decrease the primitive quality of wilderness (as well as the undeveloped quality). Restrictions on visitors in wilderness can reduce the unconfined quality of wilderness.

**Other Features of Value:** Historic and cultural resources serve as reminders that humans have been using the wilderness for centuries. This value can be affected by preservation, removal, or degradation of these resources.

Scientific values would be affected if there is a change to the level and type of research conducted. The NPS does not plan to change science activities under this WSP/DEIS. See appendix P.

## **IMPACTS OF ALTERNATIVE 1: NO-ACTION / STATUS QUO**

Under the no-action alternative, wilderness would continue to be managed under the guidance established by the 2007 *General Management Plan (GMP)*, 1986 *Backcountry Management Plan (BMP)* and 1986 *Stock Use and Meadow Management Plan (SUMMP)*.

**Untrammelled Quality:** Overall, the untrammelled quality is well preserved in the parks' wilderness (Frenzel and Fauth 2014); this would be expected to continue. There are small-scale and short-term adverse effects on this quality from ongoing management activities, which are undertaken primarily with the goal of improving the natural quality. For example, wilderness rangers have removed and restored hundreds of campsites, fire pits, and fire rings to direct use away from sensitive areas and to reduce the signs of human occupation. Trail crews restore braided (short-cut) trails and reroute trails that traverse meadows to restore the natural hydrologic function of the meadow and to eliminate or minimize adverse effects on meadow resources. While these actions take place, there is an adverse impact on the untrammelled quality of wilderness because natural processes are interrupted. Once restoration is complete and manipulation ceases, natural processes would be restored to a more naturally functioning condition in the areas treated. These trammeling effects are short-term, and the continuation of these activities is necessary to improve or preserve the natural quality of wilderness. Another trammeling action that occurs is the mitigation of hazard trees from designated camp areas and around structures located in wilderness. Trees or portions of trees determined to be hazardous can be trimmed, limbed, or cut down to reduce risk to wilderness users and facilities. This is considered a trammeling action as it alters the natural processes (by not allowing the tree to decompose and fall naturally). This results in a short-term trammel. The trees or tree parts are left on site to decompose naturally, which in the long term benefits the natural quality of wilderness.

Eradication of invasive or nonnative species and large-scale meadow restoration projects and other park interventions are discussed under cumulative impacts.

**Natural Quality:** The no-action alternative would allow for the continued preservation of the natural quality of wilderness. Generally, the primary stressors that degrade the natural quality of wilderness originate from outside the parks (Frenzel and Fauth 2014) and are beyond the ability of the parks to affect. Park administrative actions under alternative 1 would continue to protect the natural quality of wilderness through restrictions and regulations on visitor use. For example, existing designated campsites concentrate use, preventing more widely dispersed impacts in surrounding areas. Party size limits or access restrictions also protect the natural quality by reducing trailing and use in more sensitive areas.

Ongoing recreational use of wilderness can cause adverse impacts on a limited scale. Under alternative 1, recreational campfires would be allowed in 398,829 acres of the total 837,806 acres of wilderness (48% of the wilderness). This results in campfires allowed in 44,212 acres of high-elevation conifer habitat that supports the four subalpine long-lived tree species (whitebark pine [*Pinus albicaulis*], foxtail pine [*P. balfouriana* ssp. *austrina*], limber pine [*P. flexilis*] and Sierra juniper [*Juniperus grandis*]), resulting in potential impacts on these species in those areas from firewood collection. This would affect the natural quality of wilderness by allowing the removal of native vegetation and downed wood of ecological and particular scientific value. Other aspects of visitor use would continue to have little effect on alpine vegetation and special-status plant species under this alternative. There would be continued effects from trampling along trail corridors and travel in off-trail areas. Under current use levels and patterns, vegetation in untrailed alpine areas would remain largely undisturbed and the natural quality would be protected. Similarly, trampling by hikers of plants of conservation concern would be infrequent under current levels and patterns of use. Although species in meadows and uplands could suffer incidental trampling by visitors traveling through meadows or on cross-country routes, this would not be expected to result in population level impacts, and the natural quality of wilderness would continue to be preserved.

There have been alterations on the natural quality of wilderness from the development of informal and formal campsites in wilderness. As stated in chapter 3, campsite condition is used to assess effects of visitor use on the natural quality of wilderness character. The 2006–2007 campsite condition survey revealed that most of the campsites in wilderness were not highly impacted, and that campsite conditions in the wilderness of Sequoia and Kings Canyon National Parks have improved dramatically since the late

1970s. The aggregate campsite impact in 2006–2007 was less by about one-third than what it was in the 1970s. Campsite condition improvements were uniform throughout the wilderness of the parks. However, despite these wilderness-wide improvements, campsite impacts are not evenly distributed in the parks. There are more substantial impacts along primary trails (particularly the JMT), and at trail junctions, creek crossings, and along lakeshores.

Wilderness visitation data shows that use levels in the parks are not as high today as use levels were in the 1970s. In addition, there has been widespread adoption of minimum-impact techniques, such as Leave No Trace<sup>®</sup>, and some activities with high impact potential (e.g., campfire building and traveling with large stock groups) are more tightly regulated than in the past. Also, the park has taken action to minimize impacts through campsite, trail, and meadow restoration. All of these factors have improved campsite conditions in the parks. Under the no-action alternative, campsite conditions would remain as is or improve in most areas, but the most popular areas would continue to experience adverse impacts.

Although visitor practices in wilderness have improved over the past few decades, resulting in a reduced impact on the natural quality of the parks' wilderness, visitor use would continue to slightly adversely impact this quality in the long term. However, the current visitor management of the parks' wilderness has resulted in a long-term beneficial effect on the natural quality since designation.

Human and stock traffic on trails can cause erosion of soil at an unnatural rate, trample native vegetation, and introduce nonnative plants. Because trails route visitors and stock to specific travelways, concentrating use and impacts, the overall effects on the natural quality are reduced. Appropriate trail design and maintenance can, however, also reduce the effects of human and stock traffic by channeling traffic onto durable or hardened surfaces.

Some studies have found that stock parties contribute more to the physical impact on the natural quality than do hiking parties. Dale and Weaver (1974) examined the effects of horses and hikers in the Rocky Mountains in Montana and found that trails used by stock parties were 2.5 times deeper than trails used only by hikers. Cole (1983) studied campsite impacts in the Bob Marshall Wilderness and found that stock sites were six times as large, with a bare area four times larger than backpacker sites. Stock sites also had more than 10 times as many damaged trees, were more severely compacted, and had more introduced plant species. The greater compaction occurs because stock are heavier than humans and their weight is concentrated on a smaller surface area (Cole 1989a). However, both stock use and overall use was higher in the Bob Marshall Wilderness than in Sequoia and Kings Canyon National Park wilderness areas. The impact of stock on campsite conditions in the Sequoia and Kings Canyon National Parks' wilderness was recently shown to be notably less than that of the Bob Marshall Wilderness (Cole and Parsons 2013).

Stock grazing in the parks can affect the natural quality. Grazing levels would likely continue to be similar to the 10-year average of 6,058 stock nights, and would be expected to occur in approximately 110 forage areas each year. Unless use patterns or levels change markedly, grazing would be expected to occur in less than half of the areas open to grazing. In the other half, grazing would rarely occur, despite its allowance. Stock use would continue to be highly variable at the meadow scale, with some meadows having significant use in one year and none the next. Most of the meadows and forage areas open to grazing would continue to be grazed at relatively light intensities, although those that are strategically located along travel routes and in popular destinations would periodically be grazed at moderate to relatively heavy intensities. Grazing affects individual plants, and can result in impacts on vegetation composition and structure, soil stability, and ecosystem processes (McClaran and Cole 1993). Stock use can also increase the potential for the introduction of nonnative species, which can alter the natural quality of wilderness. If the introduced species is highly invasive, the potential for large-scale adverse effects on the natural quality of wilderness is increased. Under the no-action alternative, grazing



management would be informed through the application of grazing capacities based on forage production and site suitability, opening dates, night and head limits, and temporary restrictions as conditions indicated. Monitoring of stock use and meadow condition would continue, including surveys for non-native plants. Continuation of current stock and grazing management policies, including protection of natural processes, visitor education, and restrictions on amounts, timing and locations of grazing and stock use, would continue to protect the natural quality of wilderness.

Human and stock waste can introduce pathogens and nutrients into soils and waterways. As discussed in the water quality section, human and stock use appears to have had little impact on water quality or on the overall health of the aquatic ecosystems in the parks' recent past. Some small but measurable impacts have occurred, especially near the most heavily used mixed-use sites (i.e., used by backpacker and stock parties). The largest measurable impacts on water quality occur during rain events. Contaminant levels taper off quickly after the rain event, and cannot be attributed to particular sources (e.g., human, pack stock, or wildlife). Because wilderness visitation in the parks has generally been stable, there would continue to be few direct adverse effects on water quality under the no-action alternative, and no long-term adverse effect on the natural quality of wilderness.

Wild animals may become conditioned to human presence, which detracts from their wild quality and affects the natural quality of wilderness. Under alternative 1, bears would continue to have benign encounters with people throughout wilderness. Habituation and human/bear conflicts would be most pronounced in areas where quality bear habitat and relatively high levels of human use overlap (e.g., Paradise Valley). Native wildlife, particularly sensitive species, can also be affected by visitor use and administrative actions in their habitat. Yosemite toad populations may be adversely affected by degradation of habitat due to the presence of trails and injury or mortality from human or stock trampling. Under alternative 1, there are few locations where Yosemite toad populations are known to exist near trails; therefore, the overall potential for degradation and trampling under this alternative would continue to be limited.

Mountain yellow-legged frog populations inhabiting areas near trails would continue to be occasionally disturbed during encounters with hikers and stock during the summer months. Mountain yellow-legged frog habitat may be adversely affected by trails and/or stock use. The potential for overall habitat degradation exists; however, impacts would be slight, as management techniques under alternative 1 would continue to minimize impacts on frogs and frog habitat.

Terrestrial invertebrates would continue to be adversely affected by stock grazing within meadows, and by human and stock trampling, particularly along trails. Aquatic invertebrates would continue to be adversely impacted by stock activity downstream from stream fording sites due to increased turbidity from erosion and impacts from stock waste. At the scale of the overall wilderness, trampling and stock grazing impacts on invertebrate populations would be limited because of the relatively small area impacted. However, on a localized scale, measurable impacts would occur. Overall, these effects would not result in a substantial adverse effect on the natural quality of wilderness.

**Undeveloped Quality:** Overall, the undeveloped quality of the parks is good due to the vastness of wilderness and the limited amount of development in wilderness. Under alternative 1, the level of visitor-management-related developments in wilderness would not change. The number of trails and signs would be maintained to their current standard. Recreational installations such as food-storage boxes, privies and toilets, and designated campsites would continue at current or close to current numbers. Ranger stations, crew camps, and the Redwood Canyon Cabin would be maintained in their current locations. New installations would require a minimum requirements analysis (MRA) and site-specific compliance to determine if these developments are the minimum necessary for the administration of wilderness.

**Opportunities for Solitude or Primitive and Unconfined Recreation:** The parks' wilderness has outstanding opportunities for solitude and for wilderness-appropriate primitive and unconfined recreation. Visitor-use data from 1990 to 2010 shows that visitation is lower in terms of total numbers of permits, people, and visitor-use days relative to the period between 1970 and 1990. Recent visitation has generally been stable wilderness-wide, but has increased in the Mount Whitney area and along the JMT and the PCT. This has resulted in greater localized crowding, a decrease in solitude along those popular trail corridors and at Mount Whitney. Off-trail areas continue to receive lower use and provide exceptional opportunities for solitude. There would be no change to this under the no-action alternative.

As described in chapter 3, encounters with other visitors can adversely affect opportunities for solitude. In results from the 2011 survey (Watson 2013), 98% of respondents said they noticed the presence of people along the trail. Most respondents indicated it did not detract from their trip; however, 21% said it did detract from their experience. Under the no-action alternative, encounter rates are likely to remain approximately the same. Visitors would continue to encounter other visitors most frequently in the popular locations in wilderness, while off-trail visitors would encounter the fewest visitors.

Management actions can adversely affect this quality of wilderness. Existing restrictions and management actions can affect opportunities for solitude or primitive and unconfined recreation. Campfire regulations, party size limits, and night limits would continue to be implemented at the parks. These could restrict opportunities for primitive and unconfined recreation, but serve to protect opportunities for solitude by reducing use in certain areas. Other management restrictions that could affect opportunities for primitive and unconfined recreation include the current campfire restrictions, which would continue, and restrictions on stock travel and grazing. Stock would continue to be allowed to travel and graze at currently permissible locations, and the amount and types of commercial services provided would continue at the parks. Visitor interactions with rangers and other park staff, which can reduce solitude and the primitive and self-reliant nature of wilderness, would continue to occur. Thus, opportunities for primitive and unconfined recreation would continue to exist at their current levels.

Trails and signs generally promote opportunities for primitive and unconfined recreation. Though some users believe that trails confine use, visitors have the opportunity to travel off trail in vast areas if they choose. There are currently access restrictions in certain areas for stock and for larger parties, which reduce opportunities for unconfined recreation. Recreational installations such as food-storage boxes, privies and toilets, and designated campsites would continue at current or close to current numbers. Commercial operations at the Pear Lake Ski Hut (winter) and the Bearpaw Meadow High Sierra Camp (summer) would also continue. These facilities support wilderness recreational activities but reduce primitive and self-reliant aspects.

Under current conditions, the parks' wilderness provides outstanding opportunities for solitude and primitive and unconfined recreation, except at a few locations where visitor densities are relatively high and impacts on solitude occur. Under the no-action alternative, no additional restrictions or developments related to visitor-use management would be proposed for wilderness, and overall visitor-use levels are considered to be stable; therefore, there would be no change to opportunities for solitude or primitive and unconfined recreation.

**Other Features of Value:** Although less than 5% of wilderness has been surveyed for cultural features, hundreds of prehistoric and historic sites have been discovered and assessed. Because the terrain often dictates the location of good campsites, prehistoric and historic sites are often located in or near modern camp areas. Using campsites that have been used by people for centuries may put cultural resources at risk. A subset of historic structures (mostly ranger stations) would continue to be preserved and maintained by park crews while others may be allowed to naturally decay, crumble, or disintegrate. This alternative does not provide for a focused assessment of trails and other historic features; thus, until such

assessment is undertaken under another program or project, the historic features may not be adequately protected.

Wilderness dependent research would continue to be recognized as appropriate and encouraged. Over the past three years, 73% of the parks' permitted research included activities in wilderness. This research covers a wide range of disciplines. The most frequent topics for research in wilderness in the past three years included investigations of vascular plants/plant communities, herpetology (amphibians and reptiles), geology, cave/karst, invertebrates, and fire (behavior, ecology and effects). Proposed research activities would continue to be evaluated on a case-by-case basis, and the scientific values of the wilderness recognized and preserved, resulting in no change under this alternative.

### **Cumulative Effects**

*Untrammelled Quality* – Many of the trammeling actions of the past have been discontinued or reduced. These include widespread fire suppression, fish stocking, control of forest pathogens and pests, control of predator populations, and large-scale meadow restoration and manipulation. Other trammeling actions are generally decreasing as the parks realize gains from past actions such as managing human/bear conflict through better education and targeted restrictions, focusing on early detection of nonnative species, and the rerouting of trails and other infrastructure away from sensitive areas. Due to its large size and ruggedness, the parks' wilderness today is largely untrammelled and has the appearance of being unimpeded by human actions. The following actions would continue to occur as needed and are not part of this WSP/DEIS, but cumulatively, may impact wilderness character.

Science-based activities that intentionally manipulate the natural processes in wilderness can affect the untrammelled quality. Generally, most research in wilderness is non-manipulative, that is, it includes monitoring or simple sampling actions that have no effect on the untrammelled quality. However, there are several projects that can result in a trammel. Activities, such as the mountain yellow-legged frog research, that include capturing and treating frogs for the chytrid fungus, results in a trammeling action. Also, bighorn sheep monitoring actions that involve capturing, collaring, and translocating sheep in wilderness result in a trammeling action.

Other resource actions that manipulate wilderness include the high-elevation aquatic ecosystem restoration program, which is underway and includes removing nonnative fish from wilderness waters. This project could be expanded in the future, depending on the outcome of an ongoing EIS; this would result in long-term trammeling actions that would restore an aspect of the natural quality of wilderness.

The Halstead Meadow Restoration project was initiated in 2008, with its final phase starting in 2017. Ecological restoration at Halstead Meadow, a portion of which is in wilderness, has five main goals including restoration of the natural quality of wilderness, including landforms, hydrologic processes, wetland vegetation, wetland functions, and the capacity to withstand 10-year flood flows prior to sod establishment. Another meadow restoration project in wilderness being assessed for future action is for Cahoon Meadow. These projects would have a short-term adverse effect on the untrammelled quality while actual restoration work is underway, but there would be a long-term trammel as this project could continue for an extended period of time.

The ongoing nonnative plant eradication program also results in a trammeling action. The trammeling action occurs when nonnative species are controlled by manual pulling, mowing, or herbicide treatment. This program is expected to continue in the long-term.

The ecological restoration program restores landscapes disturbed by human impacts or development. The trammeling action occurs when disturbed landforms are re-contoured close to their pre-disturbance state

to restore natural drainage patterns. Sites may be allowed to revegetate through natural colonization if there is limited disturbance and a nearby seed source. Revegetation techniques could include passive methods, such as applying litter and duff mulch or placing large woody debris, or active methods, such as transplanting from adjacent locations or installing plants propagated in a nursery. Project sites included in the program include marijuana grow sites, wilderness trail relocations, and campsite restorations, all of which result in localized and short-term trammeling.

The parks' Fire and Fuels Management Plan supports the use of prescribed fires, allows for the management of natural fires – either allowing them to burn or suppressing fires when appropriate – and allows for post-burn restoration actions. Fire suppression, prescribed burning, and restoration actions are trammeling actions that can occur in wilderness.

There are four dams in designated potential wilderness additions in the Mineral King area. These dams create a trammeling action by altering the temporal flow and hydrology of the affected area. These dams are likely to continue to exist in wilderness in the long term.

Climate change likely will have effects on ecosystems in the near term that may require intervention or manipulation to meet agency mandates for preservation of ecosystems and their components. State or federal listings of threatened and endangered, sensitive, or high-value species may compel park managers to take additional actions to preserve these species. The extent of these future trammeling actions is unknown at this time so the effects cannot be assessed. Considered together, there would be no meaningful additive or interactive effects between these cumulative actions and actions under this alternative. Cumulative impacts on the untrammeling quality of wilderness would not be significant.

*Natural Quality* – As stated in chapter 3, many of the agents (airborne pollutants and contaminants) that impact natural conditions in wilderness originate outside of the parks and are not directly controlled by park management actions. Current stressors on the natural quality that are not a result of park activities include air pollution and the resultant influx of contaminants, impacts from nonnative pathogens such as blister rust, and the past introduction of nonnative fish. A key challenge in preserving the natural quality of the parks' wilderness would be to determine what is possible, desirable, and feasible in maintaining ecosystems and biodiversity in the face of a changing climate.

The parks do conduct activities with intent to preserve the natural quality of wilderness. Resources management and scientific activities, mapping, and monitoring programs result in increased knowledge that can lead to better protection of native species and habitats and more strategic wilderness management overall. Therefore, these programs benefit the natural quality of wilderness.

Restoration and nonnative species removal activities (plants and nonnative fish), such as those described under *untrammeling quality*, result in a long-term improvement in the natural quality of wilderness by restoring natural ecosystem functions and protecting native species. Allowing natural fires to burn and implementing a strategic prescribed fire program also results in long-term benefits on the natural quality of wilderness by restoring natural fire to wilderness. Considered together, there would be no meaningful additive or interactive effects between these cumulative actions and actions under this alternative. Cumulative impacts on the natural quality of wilderness would not be significant.

*Undeveloped Quality* – Apart from the facilities and actions related to wilderness administration and visitor-use management, which are discussed elsewhere as direct effects of the alternatives, there are few facilities or actions in wilderness that affect the undeveloped quality.

Resource management and science, mapping, and monitoring programs (listed previously under the *untrammeling quality*) can result in the use of mechanized equipment and installation of equipment and

survey markers in wilderness, which adversely affects the undeveloped quality. Many of the installations are small (e.g., rebar stakes, survey markers, tree tags or small stream gauges), but there are certain installations that are large and in prominent locations easily noticed by wilderness users (e.g., snow towers, snow pillows). In the future, the demand for additional instrumentation (e.g., stream gauges and snow sensors) may increase as park management and scientists seek to better understand the effects of climate change in the Sierra Nevada. However, an overall goal of park managers is to limit the number of installations to the minimum size and number possible to preserve the undeveloped quality of wilderness, and any requests for installations require a minimum requirements analysis. Scientists may also seek to access their study plots using helicopters. Helicopter transport and landings in wilderness affect the undeveloped quality. All requests to use helicopters for access are handled on a case-by-case basis and must include a minimum requirement analysis.

Other resource management projects may result in adverse effects on the undeveloped quality. Some cave management actions involve the installation of cave gates and cave route markers; these are considered installations that affect the undeveloped quality of wilderness while helping preserve the natural quality of wilderness.

The park communications network includes twelve radio repeaters located within wilderness; these periodically require access by helicopter. Powerlines and dams exist and are maintained in designated potential wilderness areas; access to the dams is generally by helicopter. Motorized and mechanized equipment may also be required to maintain the powerlines and dams, as determined through a minimum requirement analysis. Existence of these facilities and the use of motorized equipment to access them affect the undeveloped quality of wilderness. Considered together, there would be no meaningful additive or interactive effects between these cumulative actions and actions under this alternative. Cumulative impacts on the undeveloped quality of wilderness would not be significant.

*Opportunities for Solitude or Primitive and Unconfined Recreation* – As stated in chapter 3, the parks' wilderness provides outstanding opportunities for solitude or primitive and unconfined recreation; however, there are some factors that may negatively affect this quality.

External factors that adversely affect opportunities for solitude include overflights and the sights and sounds of modern civilization. There have been reductions in some external factors, for example, the number of low-level military overflights has decreased. Other external factors continue to adversely affect opportunities for solitude, such as air pollution and light pollution.

Outside of the developments related to visitor-use management, and visitor and administrative presence in wilderness, the internal factors that may adversely affect opportunities for solitude include the use of helicopters (which can affect the feeling of solitude by altering the natural soundscape) and the presence of research, resource management, and monitoring crews in wilderness, which can increase encounter rates.

Opportunities for primitive and unconfined recreation are primarily affected by actions related to visitor-use management (e.g., campfire regulations and night limits), which are discussed elsewhere as direct effects of the alternatives. There are few other actions outside of the WSP that can affect these opportunities. Fire management activities may result in reduced access or area closures. Resource management actions, such as the removal of nonnative fish from high-elevation lakes, may limit access to areas temporarily, and fish removals reduce opportunities for angling. There could be area closures for restoration purposes, which reduces the unconfined nature of wilderness.

The USFS manages wilderness in neighboring national forests including the Sierra, Inyo, and Sequoia National Forests. Existing USFS plans have established trailhead quotas, stock-use restrictions, and

commercial service limits. Since these are feeder areas into the parks' wilderness, actions by the USFS to restrict access could result in reduced opportunities for primitive and unconfined recreation in the parks.

Yosemite National Park will be updating their wilderness plan beginning in 2015. The objective of updating the plan will be to provide guidance to park operations for the successful management of Yosemite's wilderness, which comprises over 95% of the park. The plan would address wilderness visitor-use management and the preservation of wilderness character. The plan update would also address the use and operation of the five High Sierra camps in Yosemite National Park. In addition, since many of the parks' wilderness users start trips in Yosemite, it is unknown at this time how that park's plans may affect opportunities for solitude or primitive and unconfined recreation in the wilderness of Sequoia and Kings Canyon National Parks. When considered with past, present, and future actions, this quality would remain stable in the long-term and there would be no significant cumulative effect.

*Other Features of Value* – Outside of the actions proposed in this WSP/DEIS, there are few management actions that could affect cultural resources in wilderness. All projects that have the potential to affect cultural resources are evaluated prior to project implementation, with a goal of avoiding adverse effects on these resources. Looting and vandalism of cultural sites and features are rare.

The scientific value of the parks' wilderness appears to be increasing, as measured by the number and quality of requests for research permits. Science-based activities permitted in the parks' wilderness (past, ongoing, and future) include activities such as inventory and monitoring, biodiversity surveys, climate change, fire history, and ecological studies. Science-based projects continue to yield results applicable both to park managers and to the wider scientific audience. Mitigating impacts of these activities on other qualities of wilderness character will continue to be necessary to balance the positive effects of scientific research with the adverse effects research has on wilderness character. NPS policies and legal mandates support scientific activities in wilderness provided they are conducted in a manner consistent with wilderness preservation and are assessed through a minimum requirements analysis process. Continuation of research projects and support of these programs would continue to have a beneficial effect on the *Other Features of Value* quality. When considered with past, present, and future actions, this quality would remain stable in the long-term and there would be no significant cumulative effect.

## **IMPACTS OF ALTERNATIVE 2: PROTECT WILDERNESS CHARACTER BY IMPLEMENTING SITE-SPECIFIC ACTIONS (NPS PREFERRED ALTERNATIVE)**

This alternative would protect the parks' fundamental and other important resource values, including wilderness character, while providing for a range of visitor experiences and opportunities similar to current conditions with some additional limits applied in specific popular and sensitive resource areas.

**Untrammeled Quality:** Similar to the no-action alternative, the primary actions affecting the untrammeled quality under alternative 2 are trail and campsite restoration and the management actions associated with designated campsites. Trail restoration would include addressing erosion issues and restoring informal trails and abandoned trails to natural conditions. These types of actions would be addressed on a case-by-case basis, but where they take place, an impact on the untrammeled quality of wilderness would occur while restoration is underway and natural processes are interrupted. Campsite restoration would occur at Guitar Lake, Kern Hot Spring, and Shepherd Pass Lake – areas that exceed the campsite condition standard that has been established under alternative 2. Campsite restoration would continue to occur as needed, primarily in the areas that receive the most use, such as along popular trail corridors. As with trail restoration, trammeling impacts would occur while restoration is underway and natural processes are interrupted, but once restoration is complete and manipulation ceases, natural processes would be restored to a more naturally functioning condition in the areas treated.

Under alternative 2, 48 food-storage boxes would be retained in the most popular areas of the parks, 26 would be removed, and 13 would be considered for removal. It is possible that food acquisition by bears or other wildlife could increase if visitors fail to properly store food in areas where food-storage boxes were removed. The changes in wildlife behavior could result in the manipulation or destruction of animals, which is a trammeling action.

Park staff would continue to monitor and remove hazard trees if needed in designated campsites, impacting the untrammeling quality of wilderness in those areas by controlling the natural process of tree mortality, decomposition, and replacement. Under alternative 2, hazard tree removal and the associated interruption of this ecological process could potentially occur at designated camps in Emerald Lake, Pear Lake, Lower Paradise Valley, and Bearpaw Meadow, or at possible future designated camps at Dusy Basin, Kearsarge Lakes basin, Middle and Upper Rae lakes, and Woods Creek Crossing.

All of these site-specific impacts on the untrammeling quality would be of a limited intensity and duration, and wilderness would in general remain dominated by natural processes.

**Natural Quality:** Under alternative 2, overall visitor-use levels would remain similar to current use levels. On a wilderness-wide scale this alternative would have few detectable effects on the natural quality of wilderness; however, site-specific changes would result in improvement on this quality that would be detectable at a local scale. These local effects result from changes in the way that campfires, food storage, human waste, camping, and hikers and stock use are managed.

New campfire restrictions would be put in place to protect downed wood resources. Campfires would be allowed in 395,710 acres (47%) of the parks' wilderness. This would prohibit campfires on an additional 3,119 acres relative to current restrictions and would protect downed wood resources and improve campsite conditions by reducing the presence of fire rings and tree injuries. However, campfires would continue to be permitted in 35,857 acres of high-elevation conifer habitat that supports the four subalpine long-lived tree species (whitebark pine, foxtail pine, limber pine, and Sierra juniper), perpetuating impacts from firewood collection in those areas.

The reduction in food-storage boxes under alternative 2 could improve vegetation conditions at specific sites where boxes are removed (see table 15 on page 101) because visitors tend to camp near food-storage boxes. However, it is likely that visitors would continue to camp in these areas since they have long been popular camp areas; therefore, any improvements would be minimal. Also, it is possible that food acquisition by bears or other wildlife could increase if visitors fail to properly store food in areas where food-storage boxes were removed. The changes in wildlife behavior could result in the manipulation or destruction of animals, which would be considered an adverse impact on the natural quality of wilderness.

Alternative 2 would reduce the reliance on privies for managing human waste. Seven public-use privies would be removed from the following locations: one at Hockett Meadow, Upper Funston, Middle Paradise, Sphinx, and Bearpaw, and two at Roaring River. One public-use privy would be added at Rock Creek Crossing. If pack-out waste kit tests are successful, five additional public-use restroom buildings or privies would be removed at Eagle Lake, Emerald Lake, Mosquito Lake, Pear Lake, and Twin Lakes. It is conceivable that the elimination of privies in some of these areas could contribute to improper management of waste by some visitors, but because the sites have been selected based on the suitability for cat-holes or carry-out bags, it is not anticipated that these effects would be detectable.

Campsite condition would be gradually improved in two areas (Guitar Lake and Kern Hot Springs, which fail to meet campsite condition standards.



Stock grazing in the parks can affect the natural quality. Grazing levels would likely continue to be similar to the 10-year average of 6,058 stock nights, and would be expected to occur in approximately 110 forage areas each year. Unless use patterns or levels change markedly, grazing would be expected to occur in less than half of the areas open to grazing. In the other half, grazing would rarely occur despite its allowance. Stock use would continue to be highly variable at the meadow scale, with some meadows having significant use in one year and none the next. Most of the meadows and forage areas open to grazing would continue to be grazed at relatively light intensities, although those that are strategically located along travel routes and in popular destinations would periodically be grazed at moderate to relatively heavy intensities. Grazing affects individual plants, and can result in impacts on vegetation composition and structure, soil stability, and ecosystem processes (McClaran and Cole 1993). Stock use can also increase the potential for the introduction of nonnative species, which can alter the natural quality of wilderness. If the introduced species is highly invasive, the potential for large-scale adverse effects on the natural quality of wilderness is increased. Under this alternative, grazing capacities based on forage production and site suitability would be applied to all park meadows open to grazing. Grazing would be managed through the application of opening dates, night and head limits, and temporary restrictions. Monitoring of stock use and meadow condition would continue, including surveys for non-native plants. Implementation of the stock and grazing management policies described in appendix D, including protection of natural processes, visitor education, and restrictions on amounts, timing and locations of grazing and stock use, would continue to protect the natural quality of wilderness.

Alternative 2 would result in a variety of changes to stock management that could affect the natural quality of wilderness. Trails closed to stock would increase by 28 miles, and 8 additional trail miles would be closed to overnight stock camping. Stock impact trail surfaces, leading to erosion; the reduction in the number of trails open to stock could reduce erosion of trails in these areas. These trail restrictions would also reduce the percentage of meadow area that is open to stock travel from 64% to 54%. New grazing restrictions would reduce the percentage of park meadow area open to grazing from 51% to 46%, which would reduce the percentage of peat-accumulating meadow area open to grazing from 70% to 67% and reduce the percentage of lakeshore meadow open to grazing from 42% to 35%. The extent and severity of trampling, grazing, and nonnative species impacts due to stock use would be expected to be reduced from current levels. Although technically open to stock travel and grazing, much of the wetland and meadow area is inaccessible to stock parties and thus stock use would continue to be concentrated in named forage areas adjacent to maintained trails. Grazing, trampling, and non-native species impacts to the natural quality outside of named forage areas would continue to be rare and of light intensity. The intensity of grazing in named forage areas (and therefore the impact on the natural quality) would be limited by grazing capacities.

Under alternative 2, the current use levels and patterns would likely remain similar to the no-action alternative. Vegetation in untrailed alpine areas would remain largely undisturbed. Similarly, trampling by hikers of plants of conservation concern would be expected to be infrequent under the use levels prescribed under alternative 2. Although species in the meadows and uplands may suffer incidental trampling by visitors traveling through meadows or on cross-country routes, this would not be expected to result in population level impacts, and the natural quality of wilderness would continue to be preserved.

There would continue to be a slight risk to individual Yosemite toads from trampling by hikers and stock. This alternative would limit stock access in some areas that contain Yosemite toad habitat, lowering the chance of disturbance, trampling and habitat degradation. Existing restrictions on stock use in Yosemite toad habitat, including limiting grazing in the Evolution Basin to walking parties with burros and llamas, would continue to provide protection to the integrity of toad breeding areas. Increased protection of Yosemite toad breeding habitat would be provided by restricting grazing in two locations in the Blue Canyon area, and by reducing party size and limiting stock travel to within 100 yards of the trail corridor in the Upper South Fork San Joaquin.

Slight beneficial effects on mountain yellow-legged frogs could occur under alternative 2, as there could be reduced potential for disturbance and trampling of mountain yellow-legged frogs due to encounters with the smaller off-trail party sizes allowed under this alternative. Additionally, mountain yellow-legged frogs could benefit from the restrictions on stock in the Upper Bubbs and Upper Funston watersheds. The potential for injury or mortality to mountain yellow-legged frog individuals from trampling exists under alternative 2; however, effects from trampling are unlikely to result in impacts at the population level. Bighorn sheep would continue to be protected under alternative 2, as research suggests few effects on sheep from visitor or stock use.

It is anticipated that invertebrate population dynamics would remain dominated by natural processes. Changes in hiker and stock use would not result in measurably different impacts on invertebrates than those occurring under current conditions.

Overall, the management actions proposed under alternative 2 would protect the natural quality wilderness-wide, and enhance the natural quality in localized areas.

**Undeveloped Quality:** Under alternative 2 there would be a reduction in most types of development in wilderness. Twenty-six out of 87 existing food-storage boxes would be removed, and another 13 out of 87 could be removed if testing proves effective. In 10 locations these removals would eliminate all food-storage boxes at the site. In 19 locations, one or more food-storage boxes would remain. Seven out of 21 public-use privies would be removed, five other sites would be tested for privy removal, and one privy would be added at Rock Creek Crossing, resulting in an overall reduction of privies. Alternative 2 would also result in the removal of 23 out of 52 stock hitch rails and 12 out of 54 stock fences and gates. There would be no change in the number of ranger stations and patrol cabins. The Redwood Canyon Cabin and associated infrastructure would be removed, restoring the undeveloped condition to this area. All crew camps would be retained, but the number of installations at each camp would be reduced. These changes would improve the undeveloped quality in many areas of wilderness.

**Opportunities for Solitude or Primitive and Unconfined Recreation:** Alternative 2 would continue to provide outstanding opportunities for solitude and primitive and unconfined recreation in many areas, but in a few areas additional management controls would reduce the unconfined quality to protect other wilderness qualities.

Alternative 2 would add restrictions on party size, camping locations, and night limits in some popular areas, therefore reducing the opportunities for unconfined recreation in those areas. The elimination of food-storage boxes in some areas would increase the unconfined quality by compelling visitors to be self-reliant in terms of food storage. Likewise, the elimination of privies in some areas would increase the unconfined quality by compelling visitors to be self-reliant in terms of managing human waste. Commercial services would be limited in the Mount Whitney Management Area, improving the unconfined and self-reliant character of that area.

Alternative 2 would apply new visitor encounter standards that would protect opportunities for solitude in most areas, and increase opportunities for solitude in up to five areas that are near or exceed the trail encounter standard: the Mount Whitney area, Evolution Basin and Valley, the JMT near Rae Lakes, the Mount Langley approach, and the trail between Crabtree Ranger Station and Trail Crest. In these areas a variety of management actions could be taken to reduce encounter frequencies, such as reducing night limits, reducing maximum party size, reducing commercial services, lowering trailhead quotas, or other measures. These measures would improve opportunities for solitude but could involve trade-offs in terms of the unconfined quality of recreation in those areas by adding new restrictions that may decrease visitor freedom and spontaneity. Alternative 2 would also reduce the largest allowable stock-party sizes and reduce off-trail party sizes for both stock and hiker parties; however, this would affect only the largest

parties (more than 12) traveling off-trail, which account for less than 1.3% of all overnight visitors (on- and off-trail).

Overall there would continue to be outstanding opportunities for solitude or primitive and unconfined recreation in the parks' wilderness.

**Other Features of Value:** Under alternative 2, the Mission 66-era ranger station at Bearpaw Meadow, a contributing element to the National Register-eligible cultural landscape, would be removed and replaced nearby with a new ranger station, reducing the value of this feature. There would be no changes proposed for scientific activities, which would protect this quality wilderness-wide.

**Cumulative Effects:** Cumulative effects from past, present, and foreseeable future actions that have the potential to affect wilderness character include research, resource management and monitoring, and administrative actions and management actions in adjacent wilderness areas as described under alternative 1. There are also external threats to wilderness character such as overflights, air pollution, and light pollution.

*Untrammelled Quality* – Under alternative 2, there would continue to be short- and long-term trammeling associated with wilderness resource management and science-based activities for the purposes of protecting and restoring the natural quality of wilderness. When considered with the ongoing trammeling in wilderness from other programs, and potential increases in trammeling as a result of changing climatic conditions, it is likely that this quality would continue to be impacted in the future. Considered together, there would be no meaningful additive or interactive effects between these cumulative actions and actions under this alternative. Cumulative impacts on the untrammelled quality of wilderness would not be significant.

*Natural Quality* – This alternative would improve some aspects of natural quality and adversely affect others in localized areas. Overall, limitations and management actions proposed under this alternative would have long-term beneficial effects on natural quality in the popular areas, and result in little change to the natural quality wilderness-wide. When considered with past, present, and future actions related to visitor use and administration of wilderness, the natural quality of wilderness would remain good, and would improve slightly in popular areas. External factors, such as climate change and air pollution, would continue to adversely affect this quality. Considered together, there would be no meaningful additive or interactive effects between these cumulative actions and actions under this alternative. Cumulative impacts on the natural quality of wilderness would not be significant.

*Undeveloped Quality* – Under alternative 2, there would be a reduction in development related to visitor use management. It is likely that there would continue to be installations added to the wilderness for the purposes of science or resources management activities, if determined necessary through the minimum requirements analysis process. However, these impacts are small when compared with the lack of development in the majority of the parks' wilderness. Considered together, there would be no meaningful additive or interactive effects between these cumulative actions and actions under this alternative. Cumulative impacts on the undeveloped quality of wilderness would not be significant.

*Opportunities for Solitude or Primitive and Unconfined Recreation* – There are few past, present, and future actions that adversely affect this quality. There may be short-term closures associated with resource management, research, and fire activities, and some slight effects on solitude as a result of visitors encountering resource, fire crew members, or other park employees; however, when considered with past, present, and future actions, along with the actions proposed in alternative 2, this quality would continue to be preserved. Considered together, there would be no meaningful additive or interactive effects between

these cumulative actions and actions under this alternative. Cumulative impacts on this quality of wilderness would not be significant.

*Other Features of Value* – A contributing element to the National Register-eligible cultural landscape at the Bearpaw Meadow High Sierra Camp would be removed (the ranger station). This would result in a long-term, localized adverse impact on the cultural landscape; however, the remaining cultural landscape would remain in place, and other cultural sites in wilderness would continue to be protected, so there would be no cumulative effect. There would be no changes proposed for scientific activities resulting in a continued beneficial effect on the value of this quality wilderness-wide. When considered with past, present, and future actions, this quality would remain stable in the long-term and there would be no significant cumulative effect.

### **IMPACTS OF ALTERNATIVE 3: PROVIDE MORE OPPORTUNITIES FOR PRIMITIVE RECREATION**

This alternative would increase opportunities for visitor use and primitive recreation by allowing higher levels of visitor use than the no-action alternative. To accommodate increased use, this alternative would provide more facilities and more restrictions on visitor behavior relative to current conditions.

**Untrammeled Quality:** Similar to the no-action alternative, the primary actions affecting the untrammeled quality that are associated with alternative 3 include trail and campsite restoration, and campsite management actions. Trail restoration would include addressing erosion issues and restoring informal trails and abandoned trails to natural conditions. These types of actions would be addressed on a case-by-case basis, but an impact on the untrammeled quality of wilderness would occur where they take place while restoration is underway and natural processes are interrupted.

Campsite restoration would occur at those areas where campsite condition standards are exceeded. Under this alternative that would include Guitar Lake and the Shepherd Pass Lake area. Campsite restoration would continue to occur as needed, primarily in the areas that receive the most use (e.g., popular trail corridors). As with trail restoration, trammeling impacts would occur while restoration is underway and natural processes are interrupted, but once restoration is complete and manipulation ceases, natural processes would be restored to a more naturally functioning condition in the areas treated.

Park staff would continue to monitor and remove hazard trees in designated campsites, impacting the untrammeled quality of wilderness in those areas by controlling the natural process of tree mortality, decomposition, and replacement. Under alternative 3, hazard-tree removal could potentially occur at designated camps.

All of these site-specific impacts on the untrammeled quality would be of a limited intensity and duration, and the wilderness would in general remain dominated by natural processes.

**Natural Quality:** Under alternative 3, daily trailhead quotas would be increased by up to 10%; however, on a wilderness-wide scale this alternative would result in few detectable impacts on the natural quality of wilderness. Localized improvements on the natural quality could occur as a result of changes in the way that trails, campfires, food storage, human waste, camping, and hiker and stock use are managed.

More than any other alternative, this alternative would result in additional trail development across wilderness. To accommodate the increased use, more trails would be upgraded to Class 3, which could result in a localized adverse impact on the natural quality along these trail corridors while trail work is being accomplished, and a long-term effect as Class 3 trails have a larger footprint than Class 2 trails. These upgrades to these existing trails would result in more structural integrity and sustainability, reduced

erosion and improved trail conditions in the long-term; therefore, there would be limited long-term adverse effects on the natural quality.

New campfire restrictions would be put in place to protect downed wood resources. Campfires would be allowed in 293,840 acres or 35% of the parks' wilderness. The prohibition of campfires on an additional 105,000 acres relative to current restrictions would protect downed wood in these areas and improve campsite conditions by reducing the presence of fire rings and tree injuries. However, campfires would continue to be permitted in 13,126 acres of high-elevation conifer habitat that supports the four subalpine long-lived tree species (whitebark pine, foxtail pine, limber pine, and Sierra juniper), perpetuating impacts from firewood collection in those areas.

Under alternative 3, all existing food-storage boxes would be retained and up to an additional 35 food-storage boxes would be placed at key locations along the JMT. Because visitors tend to camp near food-storage boxes, the increase in food-storage boxes would adversely affect vegetation conditions at specific sites where boxes are installed (see the "Alternative 3, Element 4: Food Storage" section of chapter 2). However, it is also possible that food acquisition by bears or other wildlife could decrease in areas where food-storage boxes would be installed. The resulting changes in wildlife behavior would be considered a beneficial effect on the natural quality of wilderness.

Alternative 3 would add privies at popular areas (e.g., Heather Lake and Rock Creek Crossing) for managing human waste. Four public-use privies would be removed from the following locations: Knoll Camp, Sliding Box Camp, Middle Paradise, and Upper Funston. New privies would be considered for Dusy Basin, Evolution Valley, Guitar Lake, Kearsarge Lakes basin, Mineral King lake basins, Middle and Upper Rae lakes, Redwood Canyon, Woods Creek Crossing, and other points along the JMT and PCT. The additional privies would likely contribute to improved management of waste in these popular use areas.

Camping in designated campsites would continue to be required at certain areas, and additional designated sites would be established in selected popular areas. No new impacts on soils or vegetation are anticipated because these areas are already impacted by visitor use. New designated campsites would concentrate campsite impacts and reduce dispersed use, thus reducing impacts from new camp areas. Campsite conditions would gradually improve at Guitar Lake and Shepherd Pass Lake.

Stock grazing in the parks can affect the natural quality. Grazing levels would likely be greater than the 10-year average of 6,058 stock nights. Unless use patterns or levels change markedly, grazing would be expected to occur in less than half of the areas open to grazing. In the other half, grazing would rarely occur, despite its allowance. Stock use would continue to be highly variable at the meadow scale, with some meadows having significant use in one year and none the next. Most of the meadows and forage areas open to grazing would continue to be grazed at relatively light intensities, although those that are strategically located along travel routes and in popular destinations would periodically be grazed at moderate to relatively heavy intensities. Grazing affects individual plants, and can result in impacts on vegetation composition and structure, soil stability, and ecosystem processes (McClaran and Cole 1993). Stock use can also increase the potential for the introduction of nonnative species, which can alter the natural quality of wilderness. If the introduced species is highly invasive, the potential for large-scale adverse effects on the natural quality of wilderness is increased. The potential nonnative species impacts on meadows would decrease with the closure of more of the park meadows to stock access, although greater stock use could increase propagule pressure.

Under this alternative, grazing capacities based on forage production and site suitability would be applied to all park meadows open to grazing. Grazing would be managed through the application of opening dates, night and head limits, and temporary restrictions. Monitoring of stock use and meadow condition

would continue, including surveys for non-native plants. The natural quality of wilderness would continue to be protected by implementation of the stock and grazing management policies described in appendix D, including protection of natural processes, visitor education, and restrictions on amount, timing and locations of grazing and stock use.

Alternative 3 involves changes to stock management that could affect the natural quality of wilderness. Trails closed to stock would increase by 24 miles, and an additional 42 miles would be closed to overnight stock use. Stock has been shown to impact trail surfaces, leading to erosion of trails. The reduction in the number of trails open to stock would reduce erosion of trails in these areas. These actions would reduce the percentage of meadow area which is open to some form of stock travel and thus subject to trampling impacts from 64% to 55%. The percentage of park meadow area open to grazing would be reduced from 51% to 37% which would reduce the percentage of peat-accumulating meadow area from 70% to 49% and reduce the percentage of lakeshore meadow open to grazing from 42% to 27%. There would be a decrease in the extent but an increase in the severity of trampling, grazing, and nonnative species impacts due to stock use, as higher use would be concentrated in fewer destinations. Although technically open to stock travel and grazing, much of the wetland and meadow area is inaccessible to stock parties and thus stock use would continue to be concentrated in named forage areas adjacent to maintained trails. Grazing, trampling, and non-native species impacts to the natural quality outside of named forage areas would continue to be rare and of light intensity. The intensity of grazing in named forage areas (and therefore the impact on the natural quality) would be managed by the implementation of grazing capacities as described in appendix D.

Stock would not be allowed off-trail except in four areas: on the Hockett Plateau, on the Monarch Divide, in the Roaring River drainage, and along the western side of the Kern River watershed south from the Chagoopa Plateau (except the lower Big Arroyo). Grazing would not be allowed off-trail except at Ansel Lake, Chagoopa Treehouse Meadow, Crytes Lakes, Laurel Creek basin, Long Meadow (Ferguson Creek), Sugarloaf Creek confluence, and West Fork Ferguson Creek. Additional meadow closures are listed in chapter 2 under alternative 3.

The resulting changes in stock management would be considered, overall, a beneficial effect on the natural quality of wilderness in specific areas where trails and meadows are closed to stock travel and stock is not allowed to graze.

This alternative allows for an increase in use, but this use is not expected to result in a substantial increase in off-trail use. Any significant increase in levels of use or change in patterns of visitor use would be expected to result in increased trampling and/or grazing impacts on alpine vegetation. Similarly, trampling of the plants of conservation concern by hikers would be expected to be infrequent under the use levels prescribed under alternative 3. Although species in the meadows and uplands may suffer incidental trampling by visitors traveling through meadows or on cross-country routes, this would not be expected to result in population level impacts, and the natural quality of wilderness would continue to be preserved. Under alternative 3, impacts on Yosemite toads, mountain yellow-legged frogs, invertebrates and bighorn sheep would be similar to alternative 2. Impacts would be localized, or to individuals, and no measurable impacts would occur at a population level.

Overall, the management actions proposed under alternative 3 would protect the natural quality wilderness-wide, and enhance or improve the natural quality of wilderness on a localized scale.

**Undeveloped Quality:** Under alternative 3, there would be an overall increase in development. The number of crew camps, privies and food-storage boxes would increase. The Redwood Canyon Cabin would be retained. There would be a slight reduction in development with the removal of grazing structures in areas closed to grazing; 14 hitch rails and 5 fences/gates would be removed. One new fence

would be constructed. Under alternative 3, there would be more development in wilderness than the other alternatives, resulting in a long-term adverse impact on this quality.

**Opportunities for Solitude or Primitive and Unconfined Recreation:** Alternative 3 would result in improvements to opportunities for primitive and unconfined recreation in many areas, but in a few areas additional management controls would reduce the unconfined quality to protect other wilderness qualities. Alternative 3 would also allow for increased overall wilderness use, reducing the opportunity for solitude, particularly in popular areas.

The addition of food-storage boxes in some areas would decrease the unconfined quality by reducing visitors' need to be self-reliant in terms of food-storage. Likewise, the addition of privies in some areas would decrease the unconfined quality by reducing the visitors need to be self-reliant in terms of managing human waste. Alternative 3 would add restrictions on camping locations and night stay limits, therefore reducing the unconfined recreation quality in those specific areas. Commercial services would increase, thereby degrading the unconfined and self-reliant character of that specific aspect, although commercial services would possibly allow more visitors to experience the primitive quality of wilderness.

Alternative 3 would apply new visitor encounter standards that would somewhat protect opportunities for solitude in most areas; however, encounter frequency would be expected to be higher than under alternative 2. There are two areas that are near or exceed the trail encounter standards: Evolution Basin and Valley and the Mount Langley approach. In these areas a variety of management actions could be taken to reduce encounter frequencies, such as reducing night limits, reducing maximum party size, reducing commercial services, lowering trailhead quotas, or possibly other measures. These measures would improve opportunities for solitude but could involve trade-offs in terms of the unconfined quality of recreation in those areas. Under alternative 3, more encounters would be anticipated around new food-storage boxes. Increases in the provisions of commercial services would also lead to more encounters. Additional encounters with maintenance crews would be anticipated with increased crew camps and the additional Class 3 trails on a more frequent maintenance schedule. Overall, the number of encounters would increase in popular areas and along trails and reduce opportunities for solitude and self-reliance.

**Other Features of Value:** Under alternative 3, the Mission 66-era ranger station at Bearpaw Meadow, a contributing element to the National Register-eligible cultural landscape, would be removed, reducing the value of this feature. There are no proposed changes to scientific activities, which would protect this value wilderness-wide.

**Cumulative Effects:** The past, present, and foreseeable future projects in the parks' wilderness and nearby USFS lands that affect wilderness character would be the same as described under alternatives 1 and 2.

*Untrammelled Quality* – Under alternative 3, there would continue to be short- and long-term trammeling associated with wilderness resource management and restoration activities for the purposes of improving the natural quality of wilderness. When considered with the ongoing trammeling in wilderness from other programs, and potential increases in trammeling as a result of changing climatic conditions, it is likely that the untrammelled quality would continue to be impacted in the future; but on a localized basis. Considered together, there would be no meaningful additive or interactive effects between these cumulative actions and actions under this alternative. Cumulative impacts on the untrammelled quality of wilderness would not be significant.

*Natural Quality* – This alternative would improve some aspects of the natural quality (e.g., further restricting where campfires are allowed) and adversely affect others in localized areas (e.g., allowing increased visitor use and party sizes). Overall, limitations and management actions proposed under this



alternative would result in little change to the natural quality wilderness-wide. When considered with past, present, and future actions related to visitor use and administration of wilderness, the natural quality of wilderness would remain good, and would improve slightly in popular areas. External factors, such as climate change and air pollution, would continue to adversely affect this quality. Considered together, there would be no meaningful additive or interactive effects between these cumulative actions and actions under this alternative. Cumulative impacts on the natural quality of wilderness would not be significant.

*Undeveloped Quality* – Under alternative 3, increased development in wilderness would result in a long-term adverse impact on this quality. It is likely that there would continue to be installations added to the wilderness for the purposes of science or resources management activities, if determined necessary through the minimum requirements analysis process. When considered with past, present, and future actions, this quality would continue to be adversely impacted because there would be more installations in wilderness; however, these impacts are small when compared with the lack of development in the majority of the parks' wilderness. Considered together, there would be no meaningful additive or interactive effects between these cumulative actions and actions under this alternative. Cumulative impacts on the undeveloped quality of wilderness would not be significant.

*Opportunities for Solitude or Primitive and Unconfined Recreation* – There are few past, present, and future actions that adversely affect this quality. There may be short-term closures associated with resource management, research, and fire activities, and some slight effects on solitude as a result of visitors encountering resource, fire crew members, or other park employees. When considered with past, present, and future actions, along with the actions proposed in alternative 3, opportunities for primitive and unconfined recreation would improve, and opportunities for solitude would be negatively impacted in localized areas. Considered together, there would be no meaningful additive or interactive effects between these cumulative actions and actions under this alternative. Cumulative impacts on this quality of wilderness would not be significant.

*Other Features of Value* – A contributing element to the National Register-eligible cultural landscape at the Bearpaw Meadow High Sierra Camp would be removed (the ranger station). This would result in a long-term, localized adverse impact on the cultural landscape; however, the remaining cultural landscape would remain in place, and other cultural sites in wilderness would continue to be protected, so there would be no cumulative effect. There would be no changes proposed for scientific activities. When considered with past, present, and future actions, this quality would remain stable in the long-term and there would be no significant cumulative effect.

#### **IMPACTS OF ALTERNATIVE 4: EMPHASIZE UNDEVELOPED QUALITY AND NON-COMMERCIAL RECREATION**

This alternative would protect wilderness character by emphasizing opportunities for solitude and self-reliant recreation in a relatively undeveloped wilderness setting. The majority of wilderness would be managed for self-directed exploration and self-reliant travel.

**Untrammelled Quality:** Similar to the other alternatives, the primary actions affecting the untrammelled quality associated with alternative 4 include trail and campsite restoration. Trail restoration would include addressing erosion issues, and restoring informal trails and abandoned trails and trail segments back to natural conditions. These types of actions would be addressed on a case-by-case basis but, where they take place, an impact on the untrammelled quality of wilderness would occur while restoration is underway and natural processes are interrupted.

Campsite restorations would occur at those areas where campsite condition standards are exceeded. Under alternative 4, these include camp areas at Guitar Lake, Hockett Meadow, Kern Hot Spring, and Shepherd

Pass Lake. Amphitheater Lake currently meets the standard set under this alternative, but may require restoration if site conditions decline. Campsite restoration would continue to occur as needed, primarily in the areas that receive the most use (e.g., popular trail corridors). As with trail restoration, trammeling impacts would occur while restoration is underway and natural processes are interrupted, but once restoration is complete and manipulation ceases, natural processes would be restored to a more naturally functioning condition in the areas treated.

Under alternative 4, all designated campsites would be removed and those areas could be restored, resulting in a short-term trammel to improve the natural conditions. In addition, the hazard tree removal program would be halted at these locations and natural processes would be restored to a more naturally functioning condition in areas treated. All food-storage boxes would be removed, and some site restoration would occur in these areas. It is possible that food acquisition by bears or other wildlife could increase if visitors fail to properly store food in areas where food-storage boxes were removed. The changes in wildlife behavior could result in the manipulation or destruction of animals, which is a trammeling action.

All of these site-specific impacts on the untrammeled quality would be of a limited intensity and duration, and wilderness would in general remain dominated by natural processes.

**Natural Quality:** Under alternative 4, the overnight capacities would be lowered slightly from current conditions by reducing daily entry quotas at specific trailheads. This alternative would result in few detectable effects on the natural quality of wilderness. However, site-specific changes in response to reduced numbers would result in improvements on this quality that would be detectable at a local scale. The local effects result from changes in food storage, human waste, and campsite management. The more substantial effects would result from the changes in campfire restrictions and lower levels of commercial use that would occur as a result of implementing this alternative.

Campfires would be prohibited wilderness-wide. This would protect downed wood, and improve campsite conditions by reducing the presence of fire rings and tree injuries, thus improving the natural quality in large areas of wilderness where campfires were previously allowed.

Under alternative 4, all food-storage boxes would be removed. Visitors tend to congregate around food-storage boxes and create localized vegetation impacts. Natural conditions could improve in localized areas where food-storage boxes are removed and vegetation is reestablished. However, it is likely that visitors would continue to camp in these areas since they have long been popular camp areas; therefore, any improvements would be minimal. In addition, if visitors do not properly store their food, wildlife encounters could increase and result in changes to wildlife behavior and the need for more park intervention. The changes in wildlife behavior could result in the manipulation or destruction of animals, which would be considered an adverse impact on the natural quality of wilderness.

Alternative 4 would result in the removal of all privies and restrooms. It is conceivable that the elimination of privies could contribute to improper management of waste by some visitors. This could impact the natural quality in localized areas by contaminating soil or water or by affecting aesthetic qualities (e.g., the presence of toilet paper and human waste).

Under alternative 4, there would be no designated campsites in wilderness. It is likely that visitors would continue to use the formerly designated areas, but some sites could be restored to natural conditions. If site restoration occurs, this would result in a long-term beneficial effect on the natural quality in localized areas. Campsite condition would be gradually improved in four areas (Guitar Lake, Kern Hot Springs, and Shepherd Pass Lake, and Hockett Meadow), each of which fail to meet campsite condition standards. In these areas a variety of management tools could be employed, including campsite restoration, reduction of

the night stay limit, establishment of designated camps, reduction in party size limits for overnight camping, or reduction in trailhead entry quotas for trails serving those camping areas. These management actions would be applied until monitoring shows these areas to be within the campsite condition standard.

Alternative 4 would result in changes to stock management that could affect the natural quality of wilderness on a large scale by disallowing commercial and administrative stock use off-trail, and by eliminating grazing throughout the wilderness. Trails closed to stock would increase by 99 miles, and an additional 201 miles would be closed to overnight stock use. Stock has been shown to impact trail surfaces, leading to erosion. The reduction in the number of trails open to stock could reduce erosion of trails in these areas. Private stock parties would be allowed to travel in four off-trail areas, but commercial and administrative stock would not be allowed off-trail. The closure of the four off-trail areas to commercial and administrative stock would not be expected to result in changes in observed impacts, as use of these areas is currently infrequent and uncommon. Taken together, these actions would reduce the percentage of meadow area which is open to some form of stock travel and thus subject to trampling impacts from 64% to 43%. All grazing of stock would be prohibited, reducing the percentage of meadow area open to grazing from 51% to 0%. This would reduce the percentage of peat-accumulating meadow area open to grazing from 70% to 0% and reduce the percentage of lakeshore meadow open to grazing from 42% to 0%.

Grazing and trampling impacts on meadows and wetlands would be almost entirely eliminated. Nonnative species impacts on meadows and wetlands would be expected to decrease overall, although there could be a chance for increased impacts from introduced nonnative plant species in some areas if non-treated feed products were inadvertently used. The number of areas used for the holding and feeding of stock would by necessity increase with the prohibition on grazing. Should stock supported parties elect to camp in alpine areas, this could result in increased local, severe impacts on alpine vegetation. The inherent difficulty of holding animals in treeless areas, however, would be expected to limit such use in alpine locales.

Under alternative 4, due to the grazing prohibition, it is expected that there would be reduced stock use off trail, but off-trail use by hikers would likely remain similar to the no-action alternative. Vegetation in untrailed alpine areas would remain largely undisturbed. Any significant increase in levels of use or change in patterns of visitor use would be expected to result in increased trampling impacts on alpine vegetation. Similarly, trampling of the plants of conservation concern by hikers would be expected to be infrequent under the use levels prescribed under alternative 4. Although species in the meadows and uplands may suffer incidental trampling by visitors traveling through meadows or on cross-country routes, this would not be expected to result in population level impacts, and the natural quality of wilderness would continue to be preserved.

This alternative would limit stock access in many areas that contain Yosemite toad and mountain yellow-legged frog habitat, lowering the chance of trampling and habitat degradation. There would continue to be a slight risk to individual Yosemite toads and mountain yellow-legged frogs from trampling by hikers and stock. Bighorn sheep would continue to be protected under alternative 4, as research shows little effect on sheep from visitor or stock use.

Impacts on invertebrates are primarily related to trampling impacts on trail corridors, in camp areas, and in meadows. The impacts would continue to be measurable at a localized level but undetectable at the overall scale of wilderness. It is anticipated that invertebrate population dynamics would remain dominated by natural processes. Changes in hiker and stock use would not result in measurably different impacts on invertebrates than those occurring under current conditions.

Overall, the management actions proposed under this alternative would have long-term, beneficial effects on natural quality in a large portion of wilderness by prohibiting campfires and grazing and would enhance the natural quality in localized areas.

**Undeveloped Quality:** Under alternative 4, the level of development would be reduced more than in any other alternative. All 87 food-storage boxes would be removed. All existing privies and restrooms would be removed and no new privies would be constructed. Seven ranger stations and two patrol cabins would be removed, and there would be no long-term crew camps. The Bearpaw Meadow High Sierra Camp and the Redwood Canyon Cabin would be removed. All facilities associated with recreational stock use would be removed.

Bridges on Class 2 trails would be evaluated (e.g., Cartridge Creek Bridge, East Creek Bridge, Granite Creek/Upper Middle Fork Kaweah Bridge, and Big Arroyo Bridge on the Lower Kern Trail) and could be removed in the future.

These changes would improve the undeveloped quality in the wilderness by reducing the number of facilities and installations.

**Opportunities for Solitude or Primitive and Unconfined Recreation:** As stated in previous alternatives, the parks' wilderness offers outstanding opportunities for solitude or primitive and unconfined recreation. Alternative 4 would result in site-specific improvements in opportunities for solitude and primitive and unconfined recreation in many areas, but additional management controls would reduce the unconfined quality in order to protect other wilderness qualities.

Alternative 4 would add restrictions on party size, camping locations, and night limits in some popular areas, reducing the unconfined recreational quality in those areas. The elimination of food-storage boxes and privies would improve the unconfined quality by compelling visitors to be self-reliant in terms of food storage and human-waste management, respectively. Commercial services would be reduced wilderness-wide, and commercial and administrative stock use would be prohibited off-trail, reducing opportunities for primitive recreation, but improving the unconfined and self-reliant character overall. However, since off-trail travel by stock users is currently infrequent and uncommon, this restriction would affect low numbers of visitors.

Alternative 4 would apply visitor encounter standards that would protect opportunities for solitude in most areas, and increase opportunities for solitude in up to six areas that are near or exceed the trail encounter standard: the Crabtree Ranger Station to Trail Crest, Evolution Basin and Valley, the JMT near Rae Lakes, the Mount Langley approach, Mount Whitney area, and Rae Lakes Loop (lower portion). In these areas a variety of management actions could be taken to reduce encounter frequencies, such as reducing night limits, reducing maximum party size, reducing commercial services, lowering trailhead quotas, or other measures. These measures would improve opportunities for solitude but could involve trade-offs in terms of reducing the unconfined quality of recreation in those areas.

Party sizes would be reduced for hikers and stock users both on- and off-trail. This would slightly reduce opportunities for primitive and unconfined recreation by adding additional restrictions to all users, but would increase opportunities for solitude as visitors would encounter smaller party sizes off-trail.

Overall, there would continue to be outstanding opportunities for solitude or primitive and unconfined recreation in the parks' wilderness.

**Other Features of Value:** Under alternative 4, all structures affiliated with the Bearpaw Meadow High Sierra Camp (a National Register-eligible historic district), including the ranger station would be

removed. The Redwood Meadow Ranger Station, the Tyndall Creek Ranger Station, and the Simpson Meadow Patrol Cabin would be removed. These removals would result in localized, long-term, adverse effects on the historic and cultural features of wilderness. Removing the only High Sierra camp from the parks' wilderness would be an adverse effect. There would be no changes proposed for scientific activities, which would protect this quality wilderness-wide.

**Cumulative Effects:** Cumulative effects from past, present, and foreseeable future actions that have the potential to affect wilderness character include research, resource management and monitoring, administrative actions and management actions in adjacent wilderness areas as described under alternative 1. There are also external threats to wilderness character such as overflights, air pollution, and light pollution.

*Untrammelled Quality* – Under alternative 4, there would continue to be short- and long-term trammeling associated with wilderness resource management and restoration activities for the purposes of restoring the natural quality of wilderness. When considered with the ongoing trammeling in wilderness from other programs, and potential increases in trammeling as a result of changing climatic conditions, it is likely that this quality would continue to be impacted in the future. Considered together, there would be no meaningful additive or interactive effects between these cumulative actions and actions under this alternative. Cumulative impacts on the untrammelled quality of wilderness would not be significant.

*Natural Quality* – This alternative would improve some aspects of natural quality and adversely affect others in localized areas. Overall, limitations and management actions proposed under this alternative would have long-term beneficial effects on natural quality in the popular areas, and result in a slight improvement on the natural quality in large portions of wilderness. When considered with past, present, and future actions related to visitor use and administration of wilderness, the natural quality of wilderness would remain good, and would improve slightly in a larger area of the wilderness. External factors, such as climate change and air pollution, would continue to adversely affect this quality. Considered together, there would be no meaningful additive or interactive effects between these cumulative actions and actions under this alternative. Cumulative impacts on the natural quality of wilderness would not be significant.

*Undeveloped Quality* – Under this alternative, there would be a reduction in development related to visitor-use management wilderness-wide, resulting in a long-term beneficial effect on the undeveloped quality. It is likely that there would continue to be installations added to the wilderness for the purposes of science or resources management activities, if determined necessary through the minimum requirements analysis process. However, these impacts are small when compared with the lack of development in the majority of the parks' wilderness. Considered together, there would be no meaningful additive or interactive effects between these cumulative actions and actions under this alternative. Cumulative impacts on the undeveloped quality of wilderness would not be significant.

*Opportunities for Solitude or Primitive and Unconfined Recreation* – There are few past, present, and future actions that adversely affect opportunities for solitude or primitive and unconfined recreation. There may be short-term closures associated with resource management, research, and fire activities, and some slight effects on solitude as a result of visitors encountering resource, fire crew members, or other park employees; however, when considered with past, present, and future actions, along with the actions proposed in alternative 4, this quality would continue to be preserved. Considered together, there would be no meaningful additive or interactive effects between these cumulative actions and actions under this alternative. Cumulative impacts on this quality of wilderness would not be significant.

*Other Features of Value* – Under this alternative, one National Register-eligible historic district (Bearpaw Meadow High Sierra Camp) and three National Register listed or eligible historic structures would be removed. This would result in a long-term, localized adverse impact on this quality. There would continue

to be representative historic ranger stations located in wilderness, but the only historic High Sierra Camp in the parks' wilderness would be removed. The level of impacts could be mitigated through the documentation of the resources prior to removal. Other cultural resources would continue to be protected in wilderness. There would be no changes proposed for scientific activities, resulting in a continued beneficial effect on the value of this quality wilderness-wide. When considered with past, present, and future actions, overall this quality would continue to be protected and there would be no significant cumulative effect.

## **IMPACTS OF ALTERNATIVE 5: EMPHASIZE OPPORTUNITIES FOR SOLITUDE**

This alternative would protect wilderness character by reducing overall overnight visitor-use levels wilderness-wide, resulting in the enhancement of opportunities for solitude and unconfined recreation while reducing opportunities for primitive recreation.

**Untrammelled Quality:** Similar to the other alternatives, effects on the untrammelled quality that are associated with wilderness management include trail and campsite restoration. Trail restoration would include addressing erosion issues, and restoring social and abandoned trails and trail segments back to natural conditions. These types of actions would be addressed on a case-by-case basis, but an impact on the untrammelled quality of wilderness would occur where they take place while restoration is underway and natural processes are interrupted.

Campsite restoration would likely occur at campsite areas that are currently out of standard based on the measures for campsite conditions. These areas include Amphitheater Lake, Atwell-Hockett Trail, 11393 Lakes, Guitar Lake, Hockett Meadow, Kern Hot Spring, JMT-Simpson Junction, LeConte Ranger Station, Lower Dusy Lakes, Middle Dusy Basin, Shepherd Pass Lake, lakes above Tyndall, and South Dusy Lakes. Campsite restoration would continue to occur as needed, primarily in the areas that receive the most use (e.g., popular trail corridors). As with trail restoration, trammeling impacts would occur while restoration is underway and natural processes are interrupted, but once restoration is complete and manipulation ceases, natural processes would be restored to a more naturally functioning condition in the areas treated. Under alternative 5, all designated campsites would be removed and those areas could be restored, resulting in a short-term trammel to improve the natural conditions. In addition, the hazard tree removal program would be halted at these locations and natural processes would be allowed to continue without management interference. All food-storage boxes would be removed, and some site restoration would occur in these areas. It is possible that food acquisition by bears or other wildlife could increase if visitors fail to properly store food in areas where food-storage boxes were removed. The changes in wildlife behavior could result in the manipulation or destruction of animals, which is a trammeling action.

All of these site-specific impacts on the untrammelled quality would be of a limited intensity and duration, and wilderness would in general remain dominated by natural processes.

**Natural Quality:** Under alternative 5, overall visitor-use levels would be reduced; however, on a wilderness-wide scale this alternative would have few detectable effects on the natural quality of wilderness. The local improvements would result from changes in campfire, food storage, human waste, camping, and stock-use.

Campfires would be allowed in 425,276 acres of 837,806 acres, or 51% of the parks' wilderness. This would increase the area open to campfires by 26,447 acres from current restrictions; the reduction in use levels would make it possible to allow more areas to be open to campfires. Campfires would be allowed in 37,144 acres of high-elevation conifer habitat that support the four subalpine long-lived tree species (whitebark pine, foxtail pine, limber pine, and Sierra juniper), perpetuating impacts on these species from firewood collection in those areas.

Under alternative 5, all food-storage boxes would be removed. Visitors tend to camp near food-storage boxes, creating localized impacts on vegetation. However, even after the removal of the food-storage boxes, it is likely that visitors would continue to camp in these areas since they have long been popular camp areas. In addition, if visitors do not properly store their food, wildlife encounters could increase and result in changes to wildlife behavior and the need for more park intervention. The changes in wildlife behavior could result in the manipulation or destruction of animals, which would be considered an adverse impact on the natural quality of wilderness.

Under alternative 5, all privies and restrooms would be removed. It is conceivable that the elimination of privies could contribute to improper management of waste by some visitors. This could impact the natural quality in localized areas by contaminating soil or water or by affecting aesthetic qualities.

Under alternative 5, there would be no designated campsites in wilderness. It is likely that visitors would continue to use the areas, but some sites could be restored to natural conditions. If site restoration occurs, this would result in a long-term beneficial effect on the natural quality in localized areas. Campsite conditions would be gradually improved through restoration at sites currently out of standard under this alternative, including at Amphitheater Lake, Atwell-Hockett Trail, 11393 Lakes, Guitar Lake, Hockett Meadow, Kern Hot Spring, JMT - Simpson Junction, LeConte Ranger Station, Lower Dusy Lakes, Middle Dusy Basin, Shepherd Pass Lake, and South Dusy Lakes areas.

Stock grazing in the parks can affect the natural quality. Grazing levels would likely be less than the current 10-year average of 6,058 stock nights. Unless use patterns or levels change markedly, grazing would be expected to occur in less than half of the areas open to grazing. In the other half, grazing would rarely occur, despite its allowance. Stock use would continue to be highly variable at the meadow scale, with some meadows having significant use in one year and none the next. Most of the meadows and forage areas open to grazing would continue to be grazed at relatively light intensities, although those that are strategically located along travel routes and in popular destinations would periodically be grazed at moderate to relatively heavy intensities. Grazing affects individual plants, and can result in impacts on vegetation composition and structure, soil stability, and ecosystem processes (McClaran and Cole 1993). Stock use can also increase the potential for the introduction of nonnative species, which can alter the natural quality of wilderness. If the introduced species is highly invasive, the potential for large-scale adverse effects on the natural quality of wilderness is increased. Under this alternative, grazing capacities based on forage production and site suitability would be applied to all park meadows open to grazing. Grazing would be managed through the application of opening dates, night and head limits, and temporary restrictions. Monitoring of stock use and meadow condition would continue, including surveys for non-native plants. The natural quality of wilderness would continue to be protected by implementation of the stock and grazing management policies described in appendix D, including protection of natural processes, visitor education, and restrictions on amounts, timing and locations of grazing and stock use.

Alternative 5 would make a variety of changes to stock management that could affect the natural quality of wilderness. Trails closed to stock would increase by 21 miles, and trails closed to overnight stock camping would increase by 5 miles. In addition, the four off-trail travel areas would be closed to stock travel. Stock have been shown to impact trail surfaces, leading to erosion of trails. The reduction in the number of trails open to stock could reduce erosion of trails in these areas. These actions would reduce the percentage of meadow area which is open to some form of stock travel and thus subject to trampling impacts from 64% to 43%. The percentage of park meadow area open to grazing would be reduced from 51% to 36% which would reduce the percentage of the peat-accumulating meadow area open to grazing from 70% to 47% and reduce the percentage of lakeshore meadow open to grazing from 42% to 25%. The extent and severity of trampling, grazing, and nonnative species impacts would be expected to decrease with lower overall stock use due to fewer areas open to grazing.

Although technically open to stock travel and grazing, much of the wetland and meadow area is inaccessible to stock parties and thus stock use would continue to be concentrated in named forage areas adjacent to maintained trails. Grazing, trampling, and non-native species impacts to the natural quality outside of named forage areas would continue to be rare and of light intensity. The intensity of grazing in named forage areas (and therefore the impact on the natural quality) would be limited by grazing capacities.

Under alternative 5, the current use levels would be reduced. Vegetation in untrailed alpine areas would remain largely undisturbed. Trampling of the plants of conservation concern by hikers would be expected to be infrequent under the use levels prescribed under alternative 5. Although species in the meadows and uplands may suffer incidental trampling by visitors traveling through meadows or on cross-country routes, this would not be expected to result in population level impacts, and the natural quality of wilderness would continue to be preserved.

Under alternative 5, impacts on Yosemite toads, mountain yellow-legged frogs, invertebrates and bighorn sheep would be reduced with the overall reduction in use and further restrictions in off-trail travel and grazing by stock, and reduced party sizes. The reduction in visitor use and the closures of areas to stock would reduce the potential trampling impacts on the toads, frogs and invertebrates. There still could be some adverse effects on individuals, but these effects would not result in impacts at the population level. Bighorn sheep would continue to be protected under alternative 5, as research shows little effect on sheep from visitor or stock use. Overall, the management actions proposed under alternative 5 would protect the natural quality wilderness-wide, and enhance the natural quality in localized areas.

**Undeveloped Quality:** Under this alternative, there would be a reduction in developments in wilderness. All food-storage boxes, privies, and restrooms would be removed. Five ranger stations would be removed. The Redwood Canyon Cabin would be removed and the Bearpaw Meadow High Sierra Camp would be reduced in size. Twenty-eight out of 52 hitch rails and 18 out of 54 drift fences and gates would be removed. One gate would be added. These changes would improve the undeveloped quality in many areas of wilderness.

**Opportunities for Solitude or Primitive and Unconfined Recreation:** Alternative 5 would result in improvement to opportunities for solitude and decrease opportunities for primitive and unconfined recreation throughout wilderness due to decreases in the number of visitors allowed in the wilderness.

Under alternative 5, daily quotas would be reduced by 30%. Existing destination quotas at Emerald and Pear lakes would be discontinued. New destination quotas may be implemented in the future for specific popular areas. A day-use permit system with quotas would be implemented to control levels of use at popular destinations. Reduced quota levels would result in increased opportunities for solitude in wilderness, but would decrease opportunities for primitive and unconfined recreation.

The elimination of food-storage boxes would increase the unconfined quality by compelling visitors to be self-reliant in terms of food-storage. Likewise, the elimination of privies would increase the unconfined quality by compelling visitors to be self-reliant in terms of managing human waste. Commercial services would be reduced wilderness-wide, improving the unconfined and self-reliant character of wilderness.

Alternative 5 would apply new visitor encounter standards that would protect opportunities for solitude in most areas, and increase opportunities for solitude in up to six areas that are near or exceed the trail encounter standard for this alternative. These areas include the Crabtree Ranger Station to Trail Crest, Evolution Basin and Valley, the JMT near Rae Lakes, Lakes Trails, Mineral King Valley, the Mount Langley approach, Mount Whitney area, and Rae Lakes Loop (lower portion), and Road's End. In these areas a variety of management actions could be taken to reduce encounter frequencies, such as reducing



night limits, reducing maximum party size, reducing commercial services, lowering trailhead quotas, or other measures. These measures would improve opportunities for solitude but could involve trade-offs in terms of reducing the unconfined quality of recreation. Overall use would be reduced, but there would continue to be outstanding opportunities for solitude or primitive and unconfined recreation in the parks' wilderness.

**Other Features of Value:** Under alternative 5, the Bearpaw Meadow High Sierra Camp would be reduced in size. The Bearpaw Meadow Ranger Station, a contributing element to the National Register-eligible cultural landscape, would be removed, reducing the value of this feature. The alternative would result in localized, long-term, adverse effects on the historic and cultural features of wilderness. There would be no changes proposed for scientific activities, which would protect this quality wilderness-wide.

**Cumulative Effects:** Cumulative effects from past, present, and foreseeable future actions that have the potential to affect wilderness character include research, resource management and monitoring, administrative actions and management actions in adjacent wilderness areas. There are also external threats on wilderness character as described previously.

*Untrammelled Quality* – Under alternative 5, there would continue to be short- and long-term trammeling associated with wilderness resource management and restoration activities for the purposes of restoring the natural quality of wilderness. When considered with the ongoing trammeling in wilderness from other programs, and potential increases in trammeling as a result of changing climatic conditions, it is likely that this quality would be continue to be adversely affected in the future. Considered together, there would be no meaningful additive or interactive effects between these cumulative actions and actions under this alternative. Cumulative impacts on the untrammelled quality of wilderness would not be significant.

*Natural Quality* – This alternative would improve some aspects of the natural quality and adversely affect others in localized areas. Overall, reduced visitor use levels proposed under this alternative would have few detectable effects on the natural quality wilderness-wide. When considered with past, present, and future actions, the natural quality of wilderness would remain good, and would improve slightly, particularly in popular areas. External factors, such as climate change and air pollution, would continue to adversely affect this quality. Considered together, there would be no meaningful additive or interactive effects between these cumulative actions and actions under this alternative. Cumulative impacts on the natural quality of wilderness would not be significant.

*Undeveloped Quality* – Under this alternative, there would be a reduction in development wilderness-wide resulting in a long-term beneficial effect on the undeveloped quality. It is likely that there would continue to be installations added to the wilderness for the purposes of science or resources management activities, if determined necessary through the minimum requirements analysis process. However, these impacts are small when compared with the lack of development in the majority of the parks' wilderness. Considered together, there would be no meaningful additive or interactive effects between these cumulative actions and actions under this alternative. Cumulative impacts on the undeveloped quality of wilderness would not be significant.

*Opportunities for Solitude or Primitive and Unconfined Recreation* – There are few past, present, and future actions that adversely affect this quality. There may be short-term closures associated with resource management, research, and fire activities, and some slight effects on solitude as a result of visitors encountering resource, fire crew members, or other park staff. However, when considered with past, present, and future actions, along with the actions proposed in alternative 5, this quality would continue to be preserved. Considered together, there would be no meaningful additive or interactive effects between

these cumulative actions and actions under this alternative. Cumulative impacts on this quality of wilderness would not be significant.

*Other Features of Value* – A contributing element to the National Register-eligible cultural landscape at the Bearpaw Meadow High Sierra Camp would be removed (the ranger station). This would result in a long-term, localized adverse impact on a cultural landscape. However, the remaining cultural landscape would remain in place, and other cultural sites in wilderness would continue to be protected, so there would be no cumulative effect. There would be no changes proposed for scientific activities resulting in a continued beneficial effect on the value of this quality wilderness-wide. When considered with past, present, and future actions, this quality would remain stable in the long-term and there would be no significant cumulative effect.

## **CONCLUSION**

All of the alternatives result in continued trammeling in wilderness from restoration actions, but at a localized scale. All of the alternatives allow for continued trammeling related to restoring campfire rings, with alternative 4 resulting in the most restoration activities; as there would be a complete elimination of campfires in wilderness. Removing some or all food-storage boxes in alternatives 2, 4, and 5 could result in trammeling actions if bear management activities are needed as a result of increased human-bear encounters. Alternatives that allow for the continuation or expansion of designated campsites (alternatives 1, 2, and 3), would have additional trammeling related to hazard tree removal actions. Overall, the impacts on the untrammeled quality from any of the alternatives would be of a limited intensity and duration, and wilderness would remain dominated by natural processes. The trammeling actions are highly localized, short-term, and of limited intensity, therefore the trammeling effects under any of the action alternatives would not be considered significant.

Generally the primary stressors that degrade the natural quality originate from outside the parks. Recreational use of wilderness can cause impacts on a limited scale. Park actions such as limiting campfires to lower elevation areas, trail and campsite restoration, and managing or limiting grazing to protect meadow resources preserve the natural quality. The natural quality of wilderness would continue to be preserved under all alternatives, but alternatives 4 and 5 may best preserve the natural quality by disallowing campfires and grazing wilderness wide (alternative 4), and disallowing all off-trail travel by stock (alternative 5). The adverse effects on the natural quality as a result of the actions in the alternatives considered in this plan would occur at a local scale. The effects would be mitigated to reduce adverse impacts; therefore, no potential for significant effects on the natural quality exists under any of the action alternatives.

The number of installations and structures would be reduced in all of the alternatives but alternatives 1 and 3. Alternative 3 would result in more development in wilderness and therefore would result in the most adverse effects on this quality. Alternative 4 reduces development the most, resulting in the most beneficial effect on this quality. Alternatives 2 and 5 would result in a decrease in privies and food-storage boxes resulting in a slight improvement to this quality when compared to the no-action alternative. For all but alternative 3, the level of development in the parks' wilderness would remain constant or be reduced; therefore there is no potential for significant effects. However, alternative 3 would result in a significant increase in the level of development in the parks' wilderness.

The parks' wilderness has outstanding opportunities for solitude and for wilderness-appropriate primitive and unconfined recreation. However, there are currently areas considered out-of-standard with regard to encounter rates or campsite conditions. Opportunities for solitude would improve in the long-term under alternatives 4 and 5 due to lower visitor use, and solitude could be adversely affected under alternative 3 due to increased visitor use. Under alternative 2, effects on this quality wilderness-wide would be similar

to the no-action alternative with a slight improvement in opportunities for solitude in the most popular areas. All alternatives would provide opportunities for primitive and unconfined recreation. Under alternatives 4 and 5, opportunities for primitive and unconfined recreation would decrease due to lower visitor and commercial use levels. Under alternative 2, opportunities for primitive and unconfined recreation would remain at levels similar to the no-action alternative. Under alternative 3, opportunities would increase due to increases in trailhead quotas. Opportunities for solitude or primitive and unconfined recreation would be available under all alternatives; therefore there is no potential for significant effects under any alternative.

Alternatives 2, 3, 4, and 5 all result in the removal of one or more historic features from wilderness. Alternative 4 would result in the removal of three historic ranger stations and the historic Bearpaw Meadow High Sierra Camp, while alternatives 2 and 5 would remove one historic ranger station. These removals would result in localized, long-term, adverse effects on the historic and cultural features of wilderness. The level of impacts could be mitigated through the documentation of the resources prior to removal. Other cultural resources would continue to be protected in wilderness. All of the alternatives allow for continued science and research activities in wilderness. Overall, changes to other features of value would be minimal, and no potential for significant effects exists under any of the action alternatives.

## **SOILS**

### **METHODOLOGY FOR ANALYZING IMPACTS**

Impacts to soils were assessed by reviewing existing literature and characterizing the effects based on the types of impacts that could occur, and the analyzing factors that could contribute to soils impacts under each alternative. Soils are susceptible to several types of physical and chemical impacts including erosion, compaction, contamination, and direct removal. Visitor use and management action are potential sources of each of these types of impacts, although the timing of visitor use and site-specific soil conditions are important determinants of soils impacts. There are also a variety of ways in which potential soils impacts can be avoided or mitigated, including trail design and maintenance which plays a key role in reducing the potential for adverse soils impacts from recreational use. In general, the potential for adverse soils impacts is associated with the amount of visitor use, but because of factors related to timing, site conditions, and various forms of mitigation, there is little difference among the alternatives in terms of the potential for adverse impacts on soils.

### **TYPES OF IMPACTS ON SOILS**

**Erosion:** Erosion can be defined as a process of detachment and transport of soil. It is strongly impacted by four factors: 1) climate, 2) topography, 3) soil, and 4) land use (Renard et al. 1997).

Climate – principally precipitation but sometimes wind – drives erosion. Important precipitation characteristics that drive erosion include rainfall intensity (how hard it rains) and rainfall amount (how much it rains). In the Sierra Nevada, rainfall varies seasonally. Most precipitation occurs in the fall, winter, and spring, with extended rainless periods during the summer. Additionally, much of the precipitation in the winter comes in the form of snow. In the case of snow, intensity is low but an effective rainfall amount can cause extreme erosion as the accumulated water of multiple snow storms can be released quickly during spring rain on accumulated snow. Climate can also increase erosion through freeze-thaw cycles. When moist soils freeze, tightly packed particles are forced apart and many of the cohesive bonds are broken. When thawed, these soils are less cohesive for a time and thus more susceptible to erosion (Ferrick and Gatto 2005).

Topography can enhance erosion when runoff accumulates from expansive upslope areas and is focused along a few preferential flow paths. A large area upslope of a point yields longer slope lengths. Slope steepness also contributes to erosion. Steeper slopes allow water flowing across the surface to reach higher velocities. Faster waters can move more and larger soil particles.

Some soils are naturally more erodible than others. Soils are made up of a combination of organic materials and differing proportions of rock, sand, silt, and clay. The erodibility of different soils is a function of the relative abundance of rock, sand, silt, clay, and organic content, and can be determined by laboratory experiments (Wischmeier and Mannering 1969). Clays are less erodible due to their cohesive properties; sands are less erodible due to their size and mass. Silts, on the other hand, are highly erodible. They lack the cohesive properties of clays and are small enough in size to easily be transported by water flowing across the land.

Land use influences erosion by potentially modifying the vegetation that covers the soil. Vegetative cover intercepts the falling raindrop and dissipates its energy before allowing what does not evaporate to flow or drip slowly onto the soil below. Vegetation also limits soil particle detachment by forming dense root masses. An abundant root system locks soil particles that would otherwise be transported by flowing water. Land use can also modify the soil properties by reducing particle sizes (grinding) and increasing particle detachment prior to the onset of precipitation.

Land use, and grazing in particular, in peat-accumulating wetlands can have significant impacts to soils. Where deep hoof prints are formed or local water tables are lowered, peat can be exposed to an oxidizing atmosphere, which leads to desiccation and decomposition. Where vegetation is removed, lower plant production can disrupt the peat-forming processes. Where oxidation exceeds productivity, soil carbon is lost (Cooper et al. 2005).

Erosion is indicative of a system out of balance, where the energy available to move sediment is greater than the energy required to move sediment. Reduced infiltration, flow concentration, and increased slope contribute to increased energy availability; decreased particle size and particle detachment reduce energy requirements; and vegetation loss both increases energy availability and reduces energy requirements. Once a system is out of balance, erosion will continue until balance is restored (Wells et al. 2009).

**Compaction:** Soil compaction can be defined as the reduction of interstitial space that results in an increase in bulk density. Simply stated, compaction can occur any time weight is applied to a soil and the soil particles are squeezed together.

Soil compaction is generally seen as having an adverse impact in the natural environment because it disrupts almost all of the ecological benefits that soils provide (Kozlowski 1999). Compacted soils are more impervious to infiltrating precipitation. Water applied to compacted soils does not soak in but flows downslope as surface flow where it can lead to increased erosion when it reaches uncompacted soils. Also, compacted soils can be barriers to root development and compacted soils are often unvegetated. Organisms that rely on soil for habitat are often excluded from compacted soils, and by restricting the flow of air through compacted layers, the underlying soils are excluded from atmospheric exchange.

**Contamination:** The introduction of any foreign material to a soil can be considered contamination. In wilderness, soils are vulnerable to atmospheric deposition of a range of contaminants including fertilizers, pesticides, and mercury. Some of these airborne contaminants may be generated from local or regional sources, but some research suggests that global wind patterns can deliver contaminants from sources around the globe.

Wilderness soils are also subjected to direct contamination from sources within wilderness. Humans and stock excrete waste products onto or into the soils. In addition to being possible sources for biological contaminants such as *Escherichia coli* (*E. coli*), *Campylobacter*, and *Giardia*, waste products can introduce trace amounts of chemical contaminants such as pharmaceutical by-products. These contaminants have been measured in water quality samples (see the water quality section of this chapter) and it is likely that they are introduced in the soil as well.

Some fire and fire suppression activities can impact soils and cause contamination. In all cases, prescribed burns in the parks are designed to mimic or restore natural fire regimes; however, some areas that have undergone a prolonged absence of fire may experience unnaturally altered soil properties following prescribed fire activities. Rarely, chemical fire retardants may be used in wilderness when there is a significant threat to life or property. In all cases, planned and unplanned fire-related management activities in wilderness will follow minimum-impact guidelines and are discussed in depth in the *Fire and Fuels Management Plan* (2013).

**Direct Removal:** Soils can be impacted by actions that directly remove natural soils and deposit them elsewhere. Visitors may disrupt natural soils in this way when constructing cat-holes or when modifying camping areas for tent sites or other purposes. Wilderness managers may also directly remove soils in the process of installing signs or food-storage boxes, maintaining trails, or completing projects like relocating a ranger station. While these direct removals are effectively permanent, they are highly localized; therefore, they typically have very limited consequences in terms of subsequent soil impacts or impacts on vegetation.

## FACTORS THAT CONTRIBUTE TO SOIL IMPACTS

Visitor and wilderness management activities can have adverse impacts on soils. Impacts on soils tend to be concentrated along trail corridors, campsites, and other attractions such as vistas, ranger stations, and near food-storage boxes. Human foot traffic is generally seen as the method of overland locomotion that causes the least impact (Pickering 2010). The intensity of impacts can vary widely depending on a complex relation between the characteristics of the trail (or lack of a trail in the case of cross-country travel), the environment, and the type of use that the trail receives (Cole 1987). In an overview of previously published literature, Pickering (2010) found a general agreement in the literature that the higher the elevation, the less resistant the soils are to impact, thus alpine areas are more susceptible to adverse impacts. However, throughout wilderness, foot traffic has limited impacts on soils.

The timing of visitor use also plays an important role in potential impacts. The Mediterranean-type climate generally means hot, dry summers and cool, wet winters. Excessively dry and excessively wet material is more susceptible to erosion and compaction. Both local and seasonal variations determine antecedent soil moisture conditions.

Local settings also play a role in determining the extent of potential impacts. For example, wet meadows and stream crossings are more vulnerable to soil impacts related to visitor use. Trails that parallel streams can lead to a loss of vegetation and bank failure, and trails that cross streams perpendicularly can lead to bank or edge-of-field-type gully development (Poesen et al. 2003).

Impacts due to recreational and administrative stock use are similar to those from foot traffic, particularly soil compaction, erosion, loss of ground cover, and trail widening; however, the severity of impacts due to hoof traffic are potentially much greater than those resulting from foot traffic (Pickering 2010). Nutrifaction of soils due to stock use is also a potential concern as large quantities of manure and urine introduce nitrogen and phosphorous in to the natural system (Edwards et al. 1999; Westendorf 2009).

In most cases, regardless of what has created the impacts, the impacts on soil can persist long term. Site preparation, such as proper site or route selection, surface hardening and water control features can reduce impacts; however, complete restoration is difficult after impacts have occurred.

It is recognized that stock, and horses in particular, make more sediment available for erosion per user when compared to hikers (Pickering et al. 2010). Deluca et al. (1998) and Cole (1987) found that the relationship between the amount of traffic and trail erosion was curvilinear; that is, initial trail traffic is much more impactful than subsequent traffic. Evidence of this relationship is often apparent in National Parks in the form of informal trails where a few initial visitors taking a cross-country route can quickly form a well-worn trail that encourages others to follow. These studies considered use levels far below levels seen in Sequoia and Kings Canyon National Parks, and the studies lasted for a short period of time. However, if the relation holds true at high use levels and for long time intervals, then it is likely that trail erosion would approach a maximum level at very low visitation numbers and that the changes in visitor-use levels considered in this plan would not have a significant impact on total trail erosion.

To mitigate erosion, it is important to identify potential or incipient erosion and take action to maintain or achieve balance. Rapid identification of and response to deteriorating trail condition is essential to limiting soil impacts. Standards and best management practices exist to guide maintenance efforts. Rerouting trails to lower grade slopes, surface hardening, and water bars are all effective tools that allow managers to limit impacts on soils. In the case of meadows, the Stock Use and Meadow Monitoring and Management Strategy (appendix D) establishes standards of acceptable vegetation removal and bare ground. Vegetation and soil moisture conditions are used to establish grazing opening dates for meadows open to grazing in the parks' wilderness.

Like erosion, soil compaction can result from all types of visitor use and from administrative activities; it is recognized that stock can result in slightly greater compaction per user when compared to hikers because of their greater weight (Cole 1989a). Perhaps more than erosion, soil compaction is responsible for loss of vegetation along trails as water and roots are inhibited from entering the smaller pore spaces. Compacted soils are often armored against erosion, but



**Yucca in the foothills.**

they can deliver excess overland runoff to uncompacted soils, which results in increased erosion at that point.

Compaction is best mitigated by prevention. This can be accomplished by proper site selection for trails, campsites, and facilities. It is unlikely that medium gravel-sized particles or larger can be mobilized and compacted by human or hoof impacts; therefore, trails preferentially located on gravel or larger sediments will experience minimal compaction. Management actions to reverse compaction are limited, but compaction can be alleviated through natural processes if the impacting activity is removed. Successive freeze-thaw cycles, root wedging, and animal burrowing can naturally restore compacted soils.

Soil contamination in the parks' wilderness is often the result of excreted waste deposited by humans and stock. Microbial contaminants such as total coliforms, *E. coli*, *Campylobacter*, and *Giardia* can be found in excreted waste deposited on and within soils. Human and stock urine and feces are often rich in nitrogen and phosphorous and to a lesser extent can contain residual pharmaceutical compounds. These contaminants have been the subject of water quality studies in the parks, but they have not been analyzed in soil samples. Contamination due to human and stock is discussed at greater length in the "Water Quality" section of this chapter.

Contamination mitigation includes a reduction of waste either through the reduction of visitors and stock or the adoption of pack-out waste kits. Waste contamination mitigation also includes strategies to disperse waste widely so the concentration levels do not reach an impactful level or to concentrate waste in pre-selected areas that have the capacity to store or decompose the waste. Cat-holes and privies, respectively, disperse and concentrate waste throughout wilderness. In each case, proper site selection is essential to minimizing the adverse effects.

Prescribed fire activities may alter soil properties beyond the range of natural variability in areas that have seen long periods of fire exclusion. These fires would tend to be larger and hotter and may alter soil properties such as hydrophobicity (MacDonald and Huffman 2004), soil water pH (Murphy et al. 2006), or microbial biomass (Mabuhay et al. 2006).

Science in these parks has shown a marked increase in nitrate in surface waters persisting for more than one year following chemical fire retardant application (Tobin et al. 2103). Nitrate is one of a number of byproducts of chemical fire retardant, and it is possible that the nitrate is stored in the soil during dry periods and remobilized during runoff events.

Direct removal includes digging holes for waste disposal ranging from individual cat-holes to administrative privies. While the excreted waste associated with this type of impact is discussed above, the direct removal and relocation of soil is, in itself, a disturbance. Visitors can contribute to the direct removal of soil when they level their campsite or dig fire pits. Similar soil impacts can be attributed to the installation or removal of administrative structures such as ranger stations. The installation and maintenance of trail systems directly contribute to the direct removal of soil. The impacts of trail systems and maintenance are discussed below.

Visitor-related, direct-removal of soil in wilderness is generally limited to small-scale excavations such as cat-holes or other minor campsite improvements. Larger scale direct removal efforts are most often restricted to administrative activities such as privy construction, ranger station improvements or removals, and trail maintenance. With few exceptions, the direct removal of soil occurs as a consequence of management actions aimed at mitigating other soil impacts. Efforts to mitigate impact due to direct removal of soil include: proper site selection, an effort to limit scope and scale of impacts on only the area necessary, and a cost-benefit analysis weighed against the impact that the direct removal is intended to mitigate.



## **IMPACTS OF TRAILS SYSTEMS AND MAINTENANCE**

Trails are a primary recreation resource facility on which recreation activities are performed and provide access to areas without roads (Marion and Leung 2001). Trails tend to concentrate visitor impacts along specific corridors and convey visitors to pre-determined locations within wilderness. Trails are subjected to erosion, compaction, and contamination due to visitor and administrative use; trail maintenance activities often rely on direct removal of soil and rock. A properly designed trail system in many ways relies on applying direct removal (i.e., physical alteration) impacts in a thoughtful, pre-defined manner to reduce the occurrence of other impact types from appearing randomly across the landscape in the future.

A comprehensive and resource-based trail maintenance program is an important mitigating factor in limiting impacts on soils along trails. Rapid identification of and response to deteriorating trail condition is essential in limiting soil impacts. Standards and best management practices would guide maintenance efforts. Rerouting trails to lower grade slopes, surface hardening, and water bars are all effective tools that allow managers to limit impacts on soils.

Under all action alternatives (alternatives 2, 3, 4, and 5), a Trails Management Plan would be adopted. Similar in approach to the USFS trails management program, the parks would establish a trail classification system to inform the management of trails throughout wilderness. Trail classification level is often closely correlated with visitor use and can form a positive reinforcement cycle. Increasing visitor use, and the accompanying impacts, often demands greater levels of trail construction and maintenance. As trails are constructed and maintained at higher levels, they will encourage increased visitor use. A well-founded trail management plan can help managers frame trail assessment and inventory strategies, select the proper trail classification corresponding to current and anticipated visitor use, and apply proven prevention and mitigation measures at vulnerable trail segments. Overall, the results from the implementation of the Wilderness Trail Management Plan on soils would be beneficial and widespread, though there may be localized adverse effects if trails selected for downgrading continue to have high levels of use. The Wilderness Trail Management Plan more fully describes the new proposed trail classification system and impact mitigation strategies and is included as an appendix to this plan (appendix K).

## **IMPACTS OF ALTERNATIVE 1: NO-ACTION / STATUS QUO**

As discussed above, visitors, the use of stock and administrative activities impact soils in many of the same ways. Because wilderness visitation in the parks has been stable or declining over the last few decades, it is reasonable to assume that the current observed conditions are in near-equilibrium with sources of impacts. Since alternative 1 makes no changes to the management of the parks' wilderness, it is likely that the prevailing environmental conditions would persist under this alternative.

**Cumulative Effects:** Other than those ongoing projects and activities associated with the administration of wilderness (e.g., trail maintenance and visitor-use management), there are few past, present, or future foreseeable projects in the parks' wilderness that have a detectable effect on soils.

The projects that may affect soils that are separate from projects proposed by this WSP/DEIS include research and resource management projects that result in soil disturbance. One project that affects soils on a wilderness-wide basis is the Natural Resources Conservation Service soils mapping project that is occurring through 2016. Determining soil type requires excavating hundreds of holes to examine the soil and to take samples across the entire geographic area of the parks. The excavated holes are small and refilled after the sampling is completed; therefore, the impact is adverse but temporary.

The resource management projects with the potential to effect soils include the restoration of Halstead Meadow (ongoing), the proposed restoration of Cahoon Meadow, and the ongoing restoration of illegal



marijuana grow sites. These types of activities may result in temporary adverse effects during project work (e.g., soil disturbance during project work) but generally result in beneficial effects on soils once the areas are restored to natural conditions.

Fire management activities, such as allowing fires to burn or suppressing fires, including the use of fire retardant, can affect soils by altering soil properties. Since this alternative proposed no changes to the management of wilderness, except for the determination of the proper levels and types of commercial services, there would be no significant cumulative impacts associated with the alternative.

## **IMPACTS OF ALTERNATIVE 2: PROTECT WILDERNESS CHARACTER BY IMPLEMENTING SITE-SPECIFIC ACTIONS (NPS PREFERRED ALTERNATIVE)**

In general, this alternative seeks to maintain visitation into the parks' wilderness. Therefore, the impacts from continued visitor use would be similar to current conditions as described under alternative 1.

Alternative 2 allows for continued, regular trail maintenance in accordance with the Wilderness Trail Management Plan (appendix K). Under this alternative, many trails would be maintained at their current level, but site-specific actions could be taken to downgrade trail maintenance levels. In general, a reduction in maintenance levels would mean a reduction in erosion mitigation practices such as water bars or surface hardening; however, care would be taken when selecting trails for downgrade and many erosion impacts could be avoided. This alternative also allows for the establishment of new Class 1 trails (upgrading designated unmaintained routes or formalizing informal trails) to protect resources. Wilderness-wide, impacts from the alternative are not substantially different from the status quo (alternative 1) with some localized adverse impacts where trails are downgraded and some localized beneficial effects where new trails are established.

Under this alternative, some food-storage boxes would be removed and some may be relocated. The removal of food-storage boxes and potential restoration of the removal areas would benefit soils by reducing soil compaction and erosion potential in localized areas. If food-storage boxes are relocated to new areas, there would be localized adverse effects on soils in the construction area, and in the long-term compaction would occur because of increased use around the site. This alternative provides for the removal of privies and restrooms that are non-functional, or those in inappropriate locations, and installation of new privies may be considered for day use areas. The use of pack-out waste kits would be recommended or required in selected areas. The removal of privies and/or restrooms and subsequent restoration of the privy sites would benefit soils by reducing soil compaction and erosion potential in localized areas. If new privies are constructed, there would be localized adverse effects on soils in the construction area and in the long-term compaction would occur because of increased use around the privy sites. The use of pack-out waste kits would benefit the soils in localized areas because there would be no need to disturb soils for privy construction or for burying of human waste in these areas.

This alternative would recommend camp areas for stock users, and may result in the creation of formal stock-only campsites. If the selected sites are resilient to stock impacts then this would focus the area of effect in those designated camp areas, benefiting soils in locations where stock camping would be prohibited.

This alternative provides for similar levels of stock use throughout wilderness. As a result, some impacts on soils, especially compaction, devegetation, incision, and widening of trails would occur. Wilderness wide, impacts would be small, with the potential for more substantial adverse impacts at a few specific sites. These sites would generally be limited to especially steep or wet sections of the most utilized trails in wilderness, and in wet areas such as stream crossings in meadows. There would similar impacts as under alternative 1 from soil compaction at campsites, but there could be increased impacts at camping

tie-up areas where areas are closed to grazing. Effective monitoring of meadows in accordance with the Stock Use and Meadow Monitoring and Management Strategy protocols (appendix D), ranger patrols, and visitor reports would provide necessary information to minimize the impacts by restricting access and use. By closing selected sites to grazing, it would deter camping or holding of stock in meadows in these areas.

**Cumulative Effects:** This alternative reduces development, but allows for continued grazing, and would result in similar numbers of visitors and stock, wilderness-wide, as current conditions. Similar numbers of visitors would result in little change to wilderness soils.

Other than those ongoing projects and activities associated with the administration of wilderness (e.g., trail maintenance and visitor-use management), there are few past, present, or future foreseeable projects in the parks' wilderness that have a detectable effect on soils. The projects that may affect soils that are separate from projects proposed by this WSP/DEIS include research and resource management projects that result in soil disturbance. The majority of other past, present, and future foreseeable projects in wilderness have no potential for effects on soils, but several projects do have such potential, including the soils mapping project, the Cahoon Meadow Restoration, the Halstead Meadow Restoration, restoration activities related to illegal marijuana grow sites, and fire management activities, as described for alternative 1.

This alternative would result in impacts that are not substantially different from the status quo (alternative 1) with some localized adverse impacts where trails are downgraded and some localized beneficial effects where new trails are established. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

### **IMPACTS OF ALTERNATIVE 3: PROVIDE MORE OPPORTUNITIES FOR PRIMITIVE RECREATION**

In general, this alternative would allow for increased visitation in wilderness. As a result, adverse impacts on soils may increase slightly.

Trail maintenance is an important mitigating factor in limiting impacts on soils along trails. Alternative 3 allows for continued, regular trail maintenance in accordance with the Wilderness Trail Management Plan (appendix K). It also allows for the improvement of trail conditions in many areas of the parks. Improved trail conditions, including better route selection, surface hardening, and runoff control structures would mitigate many potential increases in adverse impacts along trails.

This alternative would add food-storage boxes in strategic locations, primarily in areas that visitors already tend to camp and congregate. This alternative also provides for installation of new privies in busy locations, and requires pack-out kits in the Mount Whitney area. If new food-boxes are added, and new privies are constructed, there would be localized adverse effects on soils in the construction area, and long-term adverse effects from soil compaction around the food-storage box and privy sites as a result of increased visitor use. The use of pack-out waste kits would benefit the soils in localized areas because there would be no need to disturb soils for privy construction or for burying of human waste in these areas.

With increased visitor use levels, the potential for adverse impacts on soils also increases. While impacts would be minimal wilderness-wide, some isolated sites could experience additional impacts resulting from the establishment of additional camp areas and increased informal trailing. This alternative would establish formal camp areas for stock users. If the selected sites are resilient to stock impacts then this

would focus the area of effect in those designated camp areas, benefiting soils in locations where stock camping would be prohibited.

This alternative provides for an increase in stock-party size throughout wilderness. As a result, some impacts on soils, especially compaction, devegetation, incision, and widening of trails would occur. Wilderness wide, impacts would be small, with the potential for more substantial adverse impacts at a few specific sites. These sites would generally be limited to especially steep or wet sections of the most utilized trails in wilderness, and in wet areas such as stream crossings in meadows. There would be increased soil compaction at campsites, and at camping tie-up areas. This alternative would lead to an increased potential for bank or edge-of-field gully development, especially in meadows. Effective monitoring of meadows in accordance with the Stock Use and Meadow Monitoring and Management Strategy protocols (appendix D), ranger patrols, and visitor reports would provide necessary information to minimize the impacts by restricting access and use. At the wilderness scale, many of the impacts would be offset by reducing off-trail grazing in four large sections of the parks. By closing selected sites to grazing, it would deter camping and holding of stock in meadows in these areas.

**Cumulative Effects:** This alternative allows for more visitors and increased stock use, resulting in adverse impacts on soils. But, these impacts would be temporary and in isolated areas, and the net effect would be minimal. The majority of other past, present, and future foreseeable projects in wilderness have no potential for effects on soils, but several projects do have such potential, including the soils mapping project, the Cahoon Meadow Restoration, the Halstead Meadow Restoration, restoration activities related to illegal marijuana grow sites, and fire management activities, as described under alternative 1. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

#### **IMPACTS OF ALTERNATIVE 4: EMPHASIZE UNDEVELOPED QUALITY AND NON-COMMERCIAL RECREATION**

This alternative seeks to maintain or slightly reduce visitation into the parks' wilderness. As a result, adverse impacts on soils may decrease slightly overall from reduced use.

This alternative calls for some trails to be maintained in their current condition while allowing for upgrades or downgrades to trails as appropriate. If trails are selected for upgrades and downgrades appropriately, (i.e., naturally stable trails downgraded and naturally vulnerable trails upgraded), then there would be beneficial effects. A reduction in maintenance could potentially result in degraded soil conditions should a downgraded trail selection be inappropriate.

Food-storage boxes would be removed, thus potentially reducing a focal point of human use, though the placement of food-storage boxes was initially based on existing camp areas so the resulting improvements to soil conditions would be minimal. This alternative also eliminates privies and restrooms in wilderness; this would reduce concentrated use and it would shift the burden of responsible waste disposal to individual visitors. In the event that non-compliance begins to degrade soils, restrooms in high-use areas could be returned to service. The use of pack-out waste kits would benefit the soils in localized areas because there would be no need to disturb soils for privy construction or for burying of human waste in these areas.

All designated campsites would be removed and sites could be rehabilitated under this alternative, reducing soil compaction and erosion potential in localized areas.

This alternative would close many areas of the park to commercial stock use. It would also eliminate grazing for all user types park-wide. It is likely that these restrictions would lead to reduced use by stock

wilderness-wide. As a result, some beneficial effects could be expected. Impact intensity would be low, with the greatest beneficial effects seen along steep trail segments that are particularly vulnerable to erosion, and at trail-stream crossings in wet meadows. While there is little evidence of substantial gully development in meadows under current conditions, reducing hoof traffic in meadows would reduce the likelihood of future edge-of-field gully initiation. This alternative also calls for the removal of administrative pastures in wilderness, which would provide beneficial effects on soils in these areas by removing administrative stock use from these pastures.

**Cumulative Effects:** This alternative calls for a decrease in visitor use, restricts commercial access, and eliminates grazing wilderness-wide. These changes could result in a reduction of impact intensities wilderness-wide; but as there are no recognized threats to soils under current conditions, the net benefit would be minimal. The majority of other past, present, and future foreseeable projects in wilderness have no potential for effects on soils; but several projects do have such potential, including the soils mapping project, the Cahoon Meadow Restoration, the Halstead Meadow Restoration, restoration activities related to illegal marijuana grow sites, and fire management activities. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

## **IMPACTS OF ALTERNATIVE 5: EMPHASIZE OPPORTUNITIES FOR SOLITUDE**

Under this alternative, visitor use would be reduced from current levels. Fewer visitors could result in fewer effects from visitor use overall, such as the development of social trails and new campsites.

This alternative calls for most trails to be maintained to their current or higher development class. Trail maintenance is an important mitigating factor in limiting impacts on soils along trails. Under this alternative, many trails would be maintained at their current level, but site-specific actions could be taken to downgrade trail maintenance levels. In general, a reduction in maintenance levels would mean a reduction in erosion mitigation practices such as water bars or surface hardening. However, care would be taken when selecting trails for downgrade and many erosion impacts could be avoided. Wilderness-wide, impacts from the alternative are not substantially different from the status quo (alternative 1) with some localized adverse impacts where trails are downgraded, and some localized beneficial effects where new trails are established.

Facilities, such as food-storage boxes and privies, would be removed. This would reduce concentrated use and it would shift the burden of responsible waste disposal and proper food storage to individual visitors. The effects from removing the facilities would be the same as those described under alternative 4.

There would be no designated campsites under this alternative, and no formalized camp areas for stock. If designated campsites are rehabilitated, soil compaction and erosion potential would be reduced in these locations. With reduced overall use, some beneficial effects would be expected. The greatest beneficial effects would be seen along steep trail segments or in off-trail areas that are particularly vulnerable to erosion, and at trail-stream crossings in wet meadows. While there is little evidence of substantial gully development in meadows under current conditions, reducing hoof traffic in meadows would reduce the likelihood of future edge-of-field gully initiation.

**Cumulative Effects:** This alternative calls for a decrease in the number of visitors and stock wilderness-wide, reduces development, but allows for continued grazing. Fewer visitors would result in a reduction of adverse impacts wilderness-wide; however, the net benefit would be minimal. The majority of other past, present, and future foreseeable projects in wilderness have no potential for effects on soils, but several projects do have such potential, including the soils mapping project, the Cahoon Meadow Restoration, the Halstead Meadow Restoration, restoration activities related to illegal marijuana grow

sites, and fire management activities. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

## **CONCLUSION**

Under alternative 1, the soils of the parks' wilderness would continue to be affected through erosion, compaction, contamination, and direct removal from visitor and administrative activities, including stock use. The action alternatives would result in impacts on soils that are not substantially different than those occurring under current conditions. The amount of visitor use and the amount of stock use would drive changes to the intensity of impacts on soils. Alternative 3 would increase the number of visitors and stock wilderness-wide slightly, alternative 2 would have similar numbers of visitors and stock, and alternatives 4 and 5 would decrease the number of visitors and/or stock. The effects of visitor and administrative activities are not currently posing recognizable threats on soils; therefore, it can be concluded that the minimal beneficial or adverse impacts on soils from the action alternatives would not produce significant impacts on soils.

## **WATER QUALITY**

### **METHODOLOGY FOR ANALYZING IMPACTS**

Impacts on water quality were assessed by reviewing existing literature and characterizing the effects based on the types of impacts that could occur, and the analyzing factors that could contribute to water quality impacts under each alternative. Water quality can be determined by measuring the physical, chemical, and biological indicators that can be affected by both natural and anthropogenic processes. Visitors and stock can impact water quality by introducing sediment, chemical agents, or biological contaminants into water sources. Sediment is introduced through erosion (see "Soils" section of chapter 4), chemical agents can be introduced through personal contact with water sources or contact with human or stock waste, and biological contaminants are introduced through contact with human or stock waste. While research has detected impacts associated with visitor use, no water quality effects have been detected at levels comprising an ecological or human health concern (Clow et al. 2013, Derlet et al. 2008a, Derlet et al. 2008b). Management activities may also result in water quality impacts, but these impacts would be localized. As a result, differences among the alternatives in terms of types and amounts of visitor use would not result in important differences in the resultant water quality, and water quality is expected to remain good under all alternatives.

### **TYPES OF IMPACTS ON WATER QUALITY**

This section analyzes what is known about impacts on water quality as a result of three use types: human, stock, and management actions. Over the years, there have been numerous efforts to assess the water quality in the parks' wilderness. Much of the work has used fecal indicator bacteria as a measure of water quality. The primary emphasis of this work was to investigate the potential health risks of consuming unfiltered water in wilderness, and the possible contamination sources based on visitor-use types and patterns. Occasionally, these studies also had accompanying physical and chemical water quality measurements. In addition to the scientific studies that address water quality questions, a review of the Safety Management Information Systems, an internal NPS employee health reporting database, indicates that park employees have reported seven cases of gastrointestinal distress while on duty in wilderness in the last 15 years (Payne, pers. comm., n.d.); however, it is not clear if this is a result of waterborne pathogens or unsanitary practices unrelated to wilderness waters.

**Biological Impacts of Visitation on Water Quality:** Biological impacts of visitor use on water quality in the parks' wilderness have been the focus of a variety of studies conducted in the parks. Biological impacts on water quality due to visitation vary relative to the amount of use. There are many confounding factors that have hampered efforts to attribute impacts on particular types of users. For example, many studies of coliforms in the parks compared mixed-use sites with backpacker-only sites. In all cases, these studies relied on wilderness permit data to identify mixed-use versus backpacker sites. They did not use on-the-ground measurements of how many humans, stock, or wildlife actually visited the area. The studies fail to account for differences in ease of access, remoteness, biological activity, wildlife impacts, total number of visitors, or the wide variation in the outdoor ethics among individuals. For example, it is reasonable to assume that humans who have little experience or training regarding wilderness hygiene and sanitation have more negative impacts on water quality. It is likely that this subset of inexperienced human visitors most frequently visit "mixed-use" areas because these sites tend to be easier to access, closer to park boundaries, along better maintained trails, and have abundant water among other things. At the same time, "backpacker-only" areas tend to be more remote, harder to access, may be less attractive to wildlife, and have fewer visitors. These visitors are more likely to have experience and knowledge about wilderness hygiene and low impact sanitation measures.

Setting these confounding variables aside, studies suggest that biological impacts of visitation on water quality in the parks' wilderness are limited and that water quality is very good except during storm events. One of the most frequently expressed concerns is the human health risk in wilderness associated with pathogens introduced by wildlife, humans, and/or stock. Most recently Clow et al. (2013) investigated the prevalence and magnitude of fecal indicator bacteria associated with visitor use using current USEPA (2012) standards for water quality assessment. The USEPA standards call for monitoring *E. coli* as an indicator for potential pathogenic threats to human health. Clow et al. (2013) measured *E. coli* at three study site categories determined as 1) minimal use (wildlife-only); 2) backpacker use (backpacker and wildlife); and 3) mixed use (stock, backpacker, and wildlife). Results indicated that water quality in the parks' wilderness is generally good, except during storms, and visitor use appears to have a small influence on stream water quality.

During the Clow et al. (2013) synoptic portion of the water quality study, 72 surface-water sites were sampled, resulting in an average of 2.8 colony-forming units (CFU) per 100 ml of water of *E. coli* at mixed-use sites (n=21), 1.1 CFU/100 ml at backpacker-use sites (n=9), and 0.3 CFU/100 ml *E. coli* in minimal-use sites (n=42). Although there were statistically significant differences between these visitor-use categories, the concentrations are well below standards established by the Water Quality Control Plan for the Tulare Lake Basin, Second Edition (2004). This standard states that in waters designated as REC-1 (which includes the major river systems within these parks) the fecal-coliform concentration based on a minimum of not less than five samples for any 30-day period shall not exceed a geometric mean of 200 CFU / 100 ml, nor shall more than 10% of the total number of samples taken during any 30-day period exceed 400 CFU / 100 ml. Therefore, it is reasonable to conclude that regardless of the type of visitor use, water quality in Sequoia and Kings Canyon National Parks wilderness is good.

The Clow et al. (2013) study also measured water quality in paired sites located above and below areas with different user types. In backpacker-use areas, Clow determined that there were no significant differences in water quality when comparing the two locations. However, a small adverse impact on water quality below mixed-use areas was found when compared to water above, including an increase of *E. coli*; that was found at an average of 5 CFU/100ml above mixed-use areas and 30 CFU/100ml below mixed-use areas.

In the intensively monitored sites along Whitney Creek, Clow et al. (2013) temporal variation in *E. coli* was measured throughout the basin. Spikes in *E. coli* were associated with storm events large enough to generate overland flow. Some spikes in *E. coli* were above 200 CFU/100ml at the height of the storm

runoff. While elevated, these intermittent spikes do not exceed the standard called for in the *Water Quality Control Plan for the Tulare Lake Basin* (2004) because the geometric mean of "not less than five samples for any 30-day period" does not exceed 200 CFU /100 ml. The results of this work support the finding that water quality is most degraded during and immediately following precipitation events large enough to generate overland flow. Adverse impacts associated with mixed-use likely make a negligible contribution to the decline in water quality during runoff events.

Results from this study suggest that mitigation through education would be an effective solution to combating human health risks associated with fecal microbes. Visitors who filter, treat, or avoid drinking water collected during or immediately after large storms would reduce their exposure to pathogens. Risk also tends to decrease with increasing remoteness, and visitors could further reduce their risk by considering the location of water collecting sites in relation to other high-use areas throughout the parks and treating their water accordingly.

In 1987, Suk et al. studied the relationship between human presence and occurrence of *Giardia* in streams throughout the Sierra Nevada, including within Sequoia and Kings Canyon National Parks. Nationwide, *Giardia* cysts have been found throughout the year in even the most pristine of surface waters and consumption of as few as 10 cysts have been known to cause infection in humans (USEPA 2009). Suk et al. (1987) sampled 78 locations throughout the Sierra Nevada and the highest concentration detected in the parks was two *giardia* cysts per 100 liters of water. While there was a statistically significant association between humans and *Giardia* presence, the concentrations were so low as to pose almost no threat to human health.

Derlet et al. (2004a, 04b, 06, 08a, 08b, 10) and Derlet (2008) have measured elevated concentrations of total coliform (v. *E. coli* specifically) throughout the parks. Derlet attempted to demonstrate a link between types of visitor use and total coliform; however, not all species of coliform produce ill effects and no correlation has been found between total coliform level and human health risks (USEPA 2012). Furthermore, Derlet was unable to follow USEPA standard operating procedures concerning holding times for coliform samples. The Derlet studies also attempted to distinguish between human, stock, and wildlife impacts. There is concern that the studies inaccurately attribute coliforms to specific sources due to ineffective study design and unverified assumptions made about visitor use patterns. Where management actions impact the biological components of water quality, it almost entirely parallels the impacts associated with human and stock visitors. Aside from hiking, camping, and utilizing stock to transport equipment, there are few other management actions that are likely to impact the biological components of water quality.

**Chemical Impacts of Visitation on Water Quality:** There have been a few studies of chemical impacts of visitation to wilderness water quality. Like the biological impacts, it is difficult to distinguish impacts between use types; however, there are some indications that humans may play a limited role in modifying the chemical properties of water quality, mainly through the introduction of unnatural chemical compounds associated with personal care products. The parks are currently collecting water samples for the USEPA to monitor contaminants of emerging concern (e.g., pesticides, pharmaceuticals, personal-care products, and wastewater indicators). The parks have collected a variety of "grab samples" from lakes and streams inside and outside of wilderness. Preliminary results show that N,N-Diethyl-meta-toluamide (DEET), the active ingredient in many bug repellants, and caffeine, a stimulant found in coffee and many soft drinks, can often be found in measurable quantities in areas where humans frequently visit. Infrequently, traces of prescription, over-the-counter, and illicit drugs can also be found in park wilderness waters (USEPA 2014). These results are similar to those found in Yosemite National Park (Clow et al. 2011), and it is reasonable to assume that similar conditions can be found throughout the parks' wilderness. To date, there is no evidence that these chemical contaminants pose any threat to human or ecological health.

Regardless of the source, urine and feces contain, among other things, nitrogen, phosphorus, and potassium. These elements are the main constituents of fertilizers, and where waste is deposited, soils can become enriched in these compounds. Excess nutrients are utilized by terrestrial plants and when they are delivered to waterbodies, they could contribute to increased algae growth. Like humans, stock may contribute a small but measurable quantity of pharmaceuticals and their metabolites to wilderness waters through urine and feces, but no study has been conducted to verify this assumption. Instead, studies have focused on increases in nitrogen or phosphorous in areas frequented by stock. These studies have been unsuccessful in decoupling human, stock, and wildlife impacts, but it is clear that in many cases water immediately downstream of heavily utilized, mixed-use areas (i.e., areas used by humans and stock) show increases in nitrogen or phosphorous. This is especially true immediately after rainfall events that drive overland flow and shallow surface discharge to waterbodies (Clow et al. 2013). Visitor use, whether it is human or stock, appears to have a small, but measurable impact on water quality.



**The banks of a high-elevation lake.**

Where management actions impact the chemical components of water quality, it likely parallels the impacts associated with human and stock visitors. Aside from hiking, camping, and utilizing stock to transport equipment, there are no management actions that are likely to impact the chemical components of water quality.

Management actions that can have impacts to the chemical properties of wilderness waters include prescribed fire and fire suppression activities. Prescribed burns in the parks are designed to mimic or restore natural fire regimes; however, some areas that have undergone a prolonged absence of fire may release unnatural levels of chemical constituents into surrounding waters after prescribed burning. Rarely, chemical fire retardants may be used in wilderness when there is a significant threat to life or property. Scientific studies in Sequoia and Kings Canyon National Parks has shown a marked increase in nitrate in surface waters persisting for more than one year following chemical fire retardant application (Tobin et al. 2013). Nitrate is one of a number of byproducts of chemical fire retardant, and it is presumed that the nitrate is stored in the soil during dry periods and delivered to nearby rivers during runoff events. In all cases, planned and unplanned fire-related management activities in wilderness will follow minimum-impact guidelines and are discussed in depth in the *Fire and Fuels Management Plan* (2013).

**Physical Impacts of Visitation on Water Quality:** Humans, stock, and management actions all have similar impact on the physical characteristics of water quality. All user types can impact physical water quality by increasing the rate of soil erosion near water or by directly agitating bottom sediment in lakes



and streams. As discussed above, increasing the suspended sediment in water directly impacts other physical characteristics of water.

Trails that cross streams perpendicularly can contribute to bank failure and gully development, as well as direct agitation of bottom sediments. Trails that parallel waterbodies, such as informal fishing trails or trails that circumnavigate lakes can potentially lead to significant bank failures. This can result from direct, catastrophic bank collapse or prolonged vegetation removal in the riparian zone and subsequent bank undermining and ultimately bank failure. There is little data assessing trail impacts on waterbodies throughout wilderness. The SUMMP and trail crew reports are perhaps best suited to identifying and monitoring impacts that would lead to declining physical water quality. To date, there is no indication, anecdotal or otherwise, that visitation is contributing to significant adverse impacts on physical water quality.

Management actions contribute to erosion and, thereby, affect physical water quality in a variety of different ways. In addition to hiking and using stock to access sites, which are comparable to visitor hiking and stock impacts, land managers can take a variety of actions that are unlike typical visitor impacts. Trail maintenance activities and site modifications, such as installation or removal of ranger stations or privies, are often undertaken with the intention of reducing impacts over the long term; however, short-term increases in sediment yield and a corresponding decrease in physical water quality may result.

### **IMPACTS OF ALTERNATIVE 1: NO-ACTION / STATUS QUO**

As discussed in “Chapter 3: Affected Environment,” humans and stock appear to have had little impact on water quality or on the overall health of the aquatic ecosystem when compared to environments with very little use. Some measurable impacts have occurred, especially near the most heavily utilized mixed-use sites; however, the impacts remain below accepted thresholds of health or ecological concern. When impacts have occurred, the duration of altered water quality in most cases is short term, and any introduced microbial contaminants may degrade naturally when exposed to the natural environment. Because wilderness visitation in the parks has been stable or declining over the last few decades, it is reasonable to assume that the current observed conditions are in near-equilibrium with sources of impacts. Alternative 1 makes no changes to the management of parks’ wilderness; therefore, it is likely that the prevailing environmental conditions would persist under this alternative.

**Cumulative Effects:** Other than those ongoing projects and activities associated with the administration of wilderness (e.g., trail maintenance and visitor-use management), there are few past, present, or future foreseeable projects in the parks’ wilderness that have a detectable effect on water quality. Most of the effects on water quality result from air pollution from external sources (see the “Water Quality” section of chapter 3).

The projects that may affect water quality that are separate from projects proposed by this WSP/DEIS include research and resource management projects and fire management activities that are located near or within waterbodies. Research projects around and in waterbodies may have a slight effect on water quality as a result of trampling around the shoreline and in the water, leading to increased turbidity. The resource management projects with the potential to effect water quality include the restoration of Halstead Meadow (ongoing) and the proposed restoration of Cahoon Meadow, and the ongoing restoration of illegal marijuana grow sites. These types of activities may result in temporary adverse effects during project work (e.g., increased turbidity during in-water work), but generally result in long-term beneficial effects on water quality once the areas are restored to natural conditions.

One project with the potential to adversely affect water quality, depending on the alternative selected, is the proposed high-elevation aquatic ecosystem restoration project. The proposed project would involve instream work, including netting and electrofishing to remove nonnative fish from selected high-elevation waterbodies. It also includes the proposed use of piscicides in 38 waterbodies. Stream water would be detoxified at the lower end of the treatment site using potassium permanganate. If piscicide use is selected as a treatment method, the piscicide and related potassium permanganate applications would reduce water clarity and contribute new chemical components to stream systems for the application period and in the short-term following application. Depending on environmental conditions (e.g., solar exposure, lake depth, wind, pH, etc.), most of the chemicals would break down in several days to several weeks (CDFW 2007). Because the project locations are away from the primary visitor-use areas, no additional use of chemicals is proposed under any of the alternatives in this WSP/DEIS, and the effects of the proposed project would be short-term, thus there would be no cumulative impacts on water quality.

Fire management activities, as described previously, particularly when chemical fire retardants are utilized, can alter the chemical composition of surface waters. Nitrate is one of a number of byproducts of chemical fire retardant, and it is presumed that the nitrate is stored in the soil during dry periods and delivered to nearby rivers during runoff events.

Studies suggest that the impacts of visitor use, both stock users and hikers, coupled with impacts from wildlife and other sources of pollution have little impact on water quality and play almost no role in overall ecological health. At times, there can be small but statistically significant increases in many measured constituents, including *E. coli*, in and downstream of the most heavily visited sites. Since this alternative proposed no changes to the management of wilderness, there would be no significant cumulative impacts associated with the alternative.

## **IMPACTS OF ALTERNATIVE 2: PROTECT WILDERNESS CHARACTER BY IMPLEMENTING SITE-SPECIFIC ACTIONS (NPS PREFERRED ALTERNATIVE)**

Under alternative 2, visitor use would remain at about the same levels. Therefore, the impacts from continued visitor use would be similar to current conditions as described under alternative 1.

Alternative 2 calls for the evaluation of existing privies and allows for the installation of new privies in areas where other methods have proven unsuccessful. New privies would result in beneficial effects on water quality in these areas. The removal of existing, failing privies should likewise result in small but beneficial effect on water quality. Expansion of the pack-out waste kit program to additional areas would likely improve water quality in those areas. Indications are that voluntary pack-out waste kits have been widely accepted in Mount Whitney area resulting in a beneficial effect. Expanding the voluntary use of this program would likely provide additional beneficial effects.

Alternative 2 provides for additional limits on stock travel in wilderness. Studies show that there are adverse impacts on water quality in areas that receive the greatest visitation from humans and stock. Therefore, reducing off-trail stock-party size should have a beneficial effect on water quality, but those improvements would be too small to quantify. Improvements would be isolated to areas adjacent and just downstream of the most heavily visited sites.

Alternative 2 also closes some areas to grazing in off-trail (cross-country) locations. Many of the areas to be closed are meadows associated with waterbodies. With the grazing prohibition in place, stock parties would likely avoid lengthy stays near these meadows (See the “Vegetation” section of this chapter). This would reduce the magnitude and frequency of adverse impacts concentrated in selected off-trail meadows. It should also reduce the impact on riparian zones in these locations. Riparian zones act as natural filters

and help to improve and preserve water quality. This change should result in a beneficial effect on water quality in the areas proposed for the grazing prohibition

Alternative 2 calls for the prohibition of grazing in selected meadows along trails for resource and social considerations. These closures may also result in a small, beneficial effect on water quality.

**Cumulative Effects:** This alternative would result in similar numbers of visitors and stock wilderness-wide, reduces development, but allows for continued grazing. Overall, this alternative would result in beneficial effects on water quality. The majority of other past, present, and future foreseeable projects in wilderness have no potential for effects on water resources, but several projects do have such potential, including the Cahoon Meadow Restoration, the Halstead Meadow Restoration, restoration activities related to illegal marijuana grow sites, the high-elevation aquatics ecosystem restoration program, and fire management activities. The meadows restoration projects and the restoration of illegal marijuana grow sites have the potential for highly localized beneficial effects on water quality. The high-elevation aquatics ecosystem restoration program would result in short-term adverse effects in localized waterbodies if the use of piscicides is approved, but long-term beneficial effects on aquatics species in the restoration sites. Fire management activities, such as allowing fires to burn or suppressing fires, including the use of fire retardant, can affect water quality by changing the chemical composition. Considered together there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

### **IMPACTS OF ALTERNATIVE 3: PROVIDE MORE OPPORTUNITIES FOR PRIMITIVE RECREATION**

Alternative 3 provides for increased visitor use levels in certain areas. Studies indicate that backpackers have some small adverse impact on water quality, and it is reasonable to assume that additional users will likely result in more impacts, but the impacts should remain small and the overall health of the aquatic ecosystem would not be compromised.

Alternative 3 allows for the installation of new privies in high-use areas throughout the parks. The administrative action of installing new privies may impose some small degradation to water quality during the construction phase, but this would be immediately offset by beneficial effects of properly installed privies on water quality in these more popular areas. Additionally, pack-out waste kits would be required in the Mount Whitney area. Indications are that voluntary pack-out waste kits have had been widely accepted and ecologically beneficial in the Mount Whitney area and making their use mandatory would likely provide additional beneficial effects.

Alternative 3 provides for increased stock use in the parks. In most locations, party size limits would increase by five head. Studies show that there is little impact on water quality in areas that receive the greatest visitation from humans and stock. It is reasonable to assume that increasing stock-party size will likely have some negative impact on water quality, but it is unlikely that an increase of five head would result in any measurable increase in impacts. The impacts, where they occur would be short term and isolated to areas adjacent and just downstream of the most heavily visited sites, and generally limited to a period of time immediately following significant rainfall.

Alternative 3 also prohibits grazing in most off-trail locations throughout the parks. Many off-trail grazing sites closed under this alternative are meadows associated with waterbodies. With the grazing prohibition in place, stock parties would likely avoid lengthy stays near these meadows. This should reduce the magnitude and frequency of adverse impacts concentrated in off-trail meadows. It should also reduce the impact on riparian zones in these locations. Riparian zones act as natural filters and help to improve and preserve water quality.

**Cumulative Effects:** This alternative calls for an increase in the numbers of visitors and stock wilderness-wide, increases development slightly, and allows for continued grazing, though most off-trail areas would be closed to grazing. More visitors and increased stock use would result in a negative impact on water quality, but these would be short-term and in isolated areas; therefore, the net effect would be minimal. The majority of other past, present, and future foreseeable projects in wilderness have no potential for effects on water resources, but several projects do have such potential, including the Cahoon Meadow Restoration, the Halstead Meadow Restoration, restoration activities related to illegal marijuana grow sites, the high-elevation aquatic ecosystem restoration program, and fire management activities. As discussed previously, the effects from these projects would result in both short- and long-term beneficial and adverse effects on water quality. Considered together there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

#### **IMPACTS OF ALTERNATIVE 4: EMPHASIZE UNDEVELOPED QUALITY AND NON-COMMERCIAL RECREATION**



Photo Courtesy of Alex Olow

**A snow-banked stream.**

Alternative 4 provides for a slight decrease visitor use levels in certain areas. A reduction in users may result in small beneficial effects, but at a scale too small to measure.

Alternative 4 calls for the removal of all privies and restrooms from wilderness. The public would be required to dig cat-holes, or in more popular areas, required to use pack-out waste kits. Presumably pack-out waste kits would have a use rate slightly less than the privies; therefore, the removal of privies would likely have some small adverse impacts on water quality in popular areas where pack-out kit recommendations are not followed. Indications are that voluntary pack-out waste kits have been accepted in some areas such as around Mount Whitney, with beneficial results. Expansion of the pack-out waste kit program would likely have some beneficial effects on water quality as long as guidelines are followed.

Alternative 4 calls for significantly decreased commercial stock use in the parks. It also eliminates off-trail travel for administrative and commercial stock and closes administrative pastures throughout wilderness. Studies show that there are

small, adverse impacts on water quality in areas that receive the greatest visitation from humans and stock. A significant reduction in commercial stock access would likely result in a commensurate reduction in visitors who typically choose to employ the services of commercial stock operators. This coupled with the restriction of administrative use would likely result in some beneficial effects on water

quality. In this case, changes in impact intensity may be measurable, but as there are no recognized substantial impacts, the net benefit would be ecologically insignificant.

Alternative 4 also prohibits grazing park wide. Many of the grazing sites closed under this alternative are meadows associated with waterbodies. With the grazing prohibition in place, stock parties would likely avoid lengthy stays near these meadows. This should reduce the magnitude and frequency of adverse impacts concentrated in meadows. It would likely reduce the impacts on riparian areas in these locations. Riparian areas act as natural filters and help to improve and preserve water quality. This alternative would likely result in some beneficial effects on water quality in the areas previously opened to grazing.

**Cumulative Effects:** This alternative calls for a decrease in the number of stock, restricts commercial access (and levels of services) and eliminates grazing wilderness-wide. These changes could result in a reduction of impact intensities wilderness-wide but as there are no recognized threats to water quality under current conditions, the net benefit would be minimal. The majority of other past, present, and future foreseeable projects in wilderness have no potential for effects on water resources, but several projects do have such potential, including the Cahoon Meadow Restoration, the Halstead Meadow Restoration, restoration activities related to illegal marijuana grow sites, the high-elevation aquatic ecosystem restoration program, and fire management activities. As discussed previously, the effects from these projects would result in both short- and long-term beneficial and adverse effects on water quality. Considered together there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

## **IMPACTS OF ALTERNATIVE 5: EMPHASIZE OPPORTUNITIES FOR SOLITUDE**

Alternative 5 provides for a reduction of visitor use levels wilderness wide. Wilderness visitors have a small, but adverse impact on water quality. A reduction in users would likely result in small, beneficial effects, but likely at a level below any detectable limits.

Alternative 5 calls for the removal of privies and restrooms wilderness-wide; visitors would be required to use cat-holes and pack-out waste kits would be recommended in some areas. Presumably pack-out waste kits would have a use rate slightly less than the privies; therefore, the removal of privies may have some adverse impacts on water quality in popular areas where pack-out kit recommendations are not adhered to. Indications are that voluntary pack-out waste kits have had been accepted in the Mount Whitney area. Should pack-out waste kits become widely accepted, it would likely result in small, beneficial effects on water quality park wide.

Alternative 5 provides for decreased stock use in wilderness by reducing party size and limiting where stock are allowed to travel. Studies show that there are some small adverse impacts on water quality in areas that receive the greatest visitation from humans and stock. Therefore, reducing stock-party size would likely have some beneficial effects on water quality, but the intensity of impacts would be difficult to quantify.

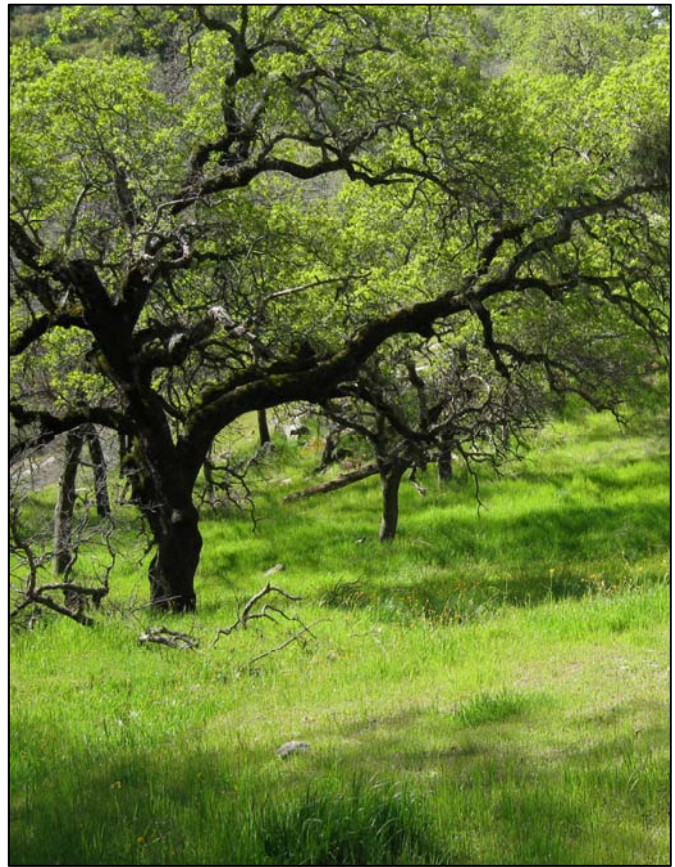
Alternative 5 prohibits off-trail stock use throughout wilderness. Many of the popular, off-trail sites closed under this alternative are meadows associated with waterbodies. This would eliminate impacts due to stock in off-trail locations. It would also reduce impacts on riparian zones in these locations. Riparian zones act as natural filters and help to improve and preserve water quality. This change would likely result in beneficial effects on water quality at off-trail locations. Changes in impact intensity may be measurable, but as there are no recognized threats to ecological health under current conditions, the net benefits of this change is minimal.



**Cumulative Effects:** This alternative calls for a decrease in the number of visitors and stock wilderness-wide, reduces development, but allows for continued grazing. Fewer visitors would result in a reduction of adverse impacts wilderness-wide; however, the net benefit would be minimal. The majority of other past, present, and future foreseeable projects in wilderness have no potential for effects on water resources, but several projects do have such potential, including the Cahoon Meadow Restoration, the Halstead Meadow Restoration, restoration activities related to illegal marijuana grow sites, the high-elevation aquatic ecosystem restoration program, and fire management activities. As discussed previously, the effects from these projects would result in both short- and long-term beneficial and adverse effects on water quality. Considered together there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

## CONCLUSION

All action alternatives would result in the potential for continued adverse effects on water quality. It is reasonable to assume that the potential for adverse water quality impacts is correlated with amounts of visitor use. Alternatives that allow for increased visitor use, such as alternative 3, may therefore result in detectable increases in water quality impacts, and alternatives that reduce visitor use, such as alternative 5, may result in detectable water quality improvements. However, current water quality conditions found throughout wilderness are generally good, the magnitude of potential effects is small, and potential effects of visitor use would be localized. Water quality changes would not be expected to affect ecologically critical areas. Importantly, biological contamination levels are typically far below the level constituting a risk to public health, and the highest biological contaminant levels result from natural rain events irrespective of the amount or type of visitor use. Therefore, neither adverse nor beneficial significant impacts are anticipated from any of the plan alternatives.



**Oak woodland in the foothills.**

## VEGETATION

### METHODOLOGY FOR ANALYZING IMPACTS

The NPS Organic Act, which directs parks to conserve “wild life” unimpaired for future generations, is interpreted to mean that native vegetation should be protected and perpetuated as part of the parks’ natural ecosystems. *NPS Management Policies 2006* defines the general principles for managing biological resources as maintaining all native plants and animals as part of the natural ecosystem. Natural processes are relied on to control populations of native species to the greatest extent possible and these species are protected from harvesting, harassment, or harm by human activities.

When NPS management actions cause native vegetation to be removed, then the NPS will seek to ensure that such removals will not cause unacceptable impacts on native resources, natural processes, or other park resources. Nonnative plants are not a natural component of the ecosystem and have the potential to have significant effects on native communities. They are managed, up to and including eradication, under the criteria specified in *NPS Management Policies 2006* and NPS-77 (Reference Manual #77: Natural Resource Management). Under Section 404 of the Clean Water Act, the U.S. Army Corps of Engineers issues permits for activities that result in the discharge of dredged or fill material into waters of the United States, including wetlands. Wetlands are protected from these and other actions through adherence to the guidance provided in *Procedural Manual #77-1: Wetland Protection* (NPS 2012b). Management goals for vegetation include maintaining components and processes of naturally evolving park ecosystems, including natural abundance, diversity, and the ecological integrity of plants and animals.

All assessments of impacts on native vegetation were conducted using the Sequoia and Kings Canyon Vegetation map (NPS 2007b) as the primary data layer. Analysis of impacts on wetland and meadow vegetation also included National Wetland Inventory spatial data (USFWS 1996) and the updated meadow layer curated by park staff. Information on the distribution of peat-accumulating wetlands was drawn from the recently completed map of peat-accumulating wetlands in Sequoia and Kings Canyon National Parks (Pyrooz et al. 2014). The evaluation of impacts on wetlands is based on both a quantitative (acreage affected) and a qualitative assessment of how each proposed alternative would affect wetland integrity.

All wetlands within the two parks fall into one of three system types: riverine (rivers, creeks, and streams), palustrine (shallow ponds, marshes, swamps, and sloughs), or lacustrine (lakes and deep ponds). The lacustrine wetland class represents wetlands and deepwater habitats that are situated in topographic depressions or dammed river channels; that lack trees, shrubs, and emergent mosses and lichens over 60% of their area; and that are greater than 20 acres in size.

Discussions of stock use levels and patterns are based on information provided in the *Summary report of stock use and grazing in wilderness meadows, 2012* (Frenzel and Haultain 2013).

To inform discussions of grazing levels and anticipated impacts to vegetation, each forage area was attributed according to vegetation zone (lower montane and woodland or upper montane and subalpine) and whether it was designated as having high logistical value for visitors and/or park staff traveling with stock. For the forage areas open to grazing under each alternative, the total area in acres and count of the number of forage areas in each combination of vegetation zone and logistical value was summarized.

To provide an assessment of current impacts to wetlands and meadows due to grazing under alternative 1, stock use data from 2008–2012 (Frenzel and Haultain 2013) and model productivity values (Ratliff et al. 1987) were used to estimate average annual utilization levels in preferred vegetation types for park forage areas. Productivity estimates based on moisture regime (dry, moist, or wet), elevation, and range condition (good) were multiplied by the total area and the proportion of the area occupied by preferred forage to estimate total forage production in pounds. The total number of stock nights in each year for each forage area was multiplied by the nightly forage consumption (32.5 lbs. per animal night) to obtain total forage consumption. Dividing the total forage consumption by forage production provided an estimate of utilization. The number and acreage of forage areas were then summarized by their estimated utilization. Potential impacts were assessed based on Ratliff (1976, 1980, 1985) for lower montane and woodland forage areas (table 75), and Cole et al. (2004) for upper montane and subalpine forage areas (table 76).

To provide an estimate of expected grazing impacts under alternatives 2, 3, and 5, the number and acreage of forage areas were summarized according to the utilization standards which would be adopted under

these alternatives; impacts for each utilization standard were predicted based on Ratliff (1976, 1980, 1985) for lower montane and woodland forage areas (table 75), and Cole et al. (2004) for upper montane and subalpine forage areas (table 76).

Appendix D, the parks’ proposed strategy for monitoring and managing stock use in wilderness, provides additional background on how utilization levels are determined and grazing capacities estimated, as well as a list of those meadows identified as having high logistical value for visitors and/or park staff traveling with stock.

**Table 75: Predicted Response of Meadow Attributes for Lower Montane and Woodland Vegetation Types to 25%, 35%, and 45% Utilization<sup>1</sup>**

Attribute	Utilization Moist <35% Dry or Wet <25%	Estimated Utilization Moist 35–45% Dry or Wet 25–35%	Utilization Moist >45% Dry or Wet >35%
Residual biomass	More than annual decomposition	More than or equal to annual decomposition	Less than annual decomposition
Productivity <sup>2</sup>	Similar to comparable ungrazed meadow vegetation	Similar to comparable ungrazed meadow vegetation	Less than comparable ungrazed meadow vegetation

<sup>1</sup> Based on Ratliff (1976, 1980, 1985)

<sup>2</sup> Response expected if grazed at this level over extended time frames

**Table 76: Predicted Mean Response of Meadow Attributes for Three Upper Montane and Subalpine Vegetation Types to 25% and 35% Utilization\***

Attribute	Vegetation Type	25% Utilization, Percentage Change Relative to Ungrazed Conditions	35% Utilization, Percentage Change Relative to Ungrazed Conditions
Productivity	<i>Carex filifolia</i>	+2%	-10%
Productivity	<i>Deschampsia cespitosa</i>	-11%	-18%
Productivity	<i>Calamagrostis muiriana</i>	-10%	-16%
Basal veg cover	<i>Carex filifolia</i>	+7%	-16%
Basal veg cover	<i>Calamagrostis muiriana</i>	+41%	+14%
Relative graminoid	<i>Calamagrostis muiriana</i>	-6%	-12%

\*Based on Cole et al. (2004); Predicted response for *Calamagrostis muiriana* is average across treatment years as reported for two, three and four years of grazing in the original study

Analysis of impacts on plants of conservation concern is limited to those species known to occur in meadows used by stock, uplands frequented by cross-country hikers and/or open to cross-country travel by stock, and destinations popular with rock climbers. Distribution data for the species evaluated is derived from the Sequoia and Kings Canyon database of plants of conservation concern, which was created as part of the Natural Resource Condition Assessment (Huber et al. 2013) and updated with information provided through the California Native Plant Society online rare plant inventory (CNPS 2014) and recent park surveys.



## **TYPES OF IMPACTS ON VEGETATION**

The types of impacts associated with vegetation that relate to visitor use and administrative activities in wilderness include direct removal, trampling, grazing, and the indirect effects associated with the introduction of nonnative invasive plant species. These are described in the following section. Because the potential for widespread and significant impacts exists only for wetlands and meadows, high-elevation long-lived trees, park sensitive plant species and alpine vegetation, impacts on these vegetation components are discussed by alternative. Impacts on other park plant species and vegetation assemblages would be negligible (see the “Impact topics Considered but Dismissed from Further Analysis” section of chapter 1) and will not be discussed.

**Direct Removal:** In national parks, intentional removal of living vegetation is generally prohibited by the public with two exceptions: harvesting of specific edible plants (as identified in the Superintendent’s compendium) and collection of wood for campfires. Vegetation removal for administrative purposes can occur during trail maintenance or construction, in designated campsites, for fire management, for scientific study, for restoration of disturbed areas, and for the removal of invasive plants. Removal of vegetation by grazing animals is addressed as a separate impact topic. Fire management, scientific study, restoration of disturbed lands, and invasive plant removal are addressed through program specific plans and compliance and are not directly affected by the actions in this plan.

Administrative vegetation removal from trail maintenance and construction occur to clear safe routes for travel by removing brush and branches that hang into the trail corridor or plants in the trail tread. Construction of new trail segments has the potential to increase the amount of vegetation removed. Increasing the level of maintenance (trail class) has the potential to remove more vegetation, as the width of the cleared area and the tread increase at higher levels of development. Establishing and maintaining designated campsites may require vegetation to be removed to provide an open camp area or to remove hazard trees.

The most widespread and common form of direct vegetation removal is the collection of wood for campfires. Campfires can cause impacts on vegetation through the removal of firewood and associated trampling that greatly enlarge the area affected by camping activities (Cole 2002). For example, a study in the Sierra Nevada found that campers travel up to approximately 200 feet from the campsite to scavenge for firewood resulting in impacts on vegetation and soils (Davilla 1979). Although collection of smaller pieces of wood for campfires is unlikely to cause adverse impacts, elimination of large woody debris is likely to reduce site productivity, particularly on droughty and infertile soils (Cole 2002) and have a variety of adverse ecological effects (Stokland et al. 2012). Decaying wood has an unusually high water-holding capacity, accumulates nitrogen, phosphorus, and sometimes calcium and magnesium, and is a significant site for nitrogen-fixing microorganisms. Of particular importance, ectomycorrhizal fungi (organisms that develop a symbiotic association with the roots of many plants) that improve the plants’ ability to extract water, nitrogen, and phosphate from less fertile soils, are concentrated in decayed wood. It is also the preferred substrate for seedling establishment and subsequent growth of certain species (Cole 2002). Shifts in understory species have also been documented and attributed to disturbance by firewood collection (Saunders 1979). There are also the direct impacts of the campfire itself, which alters organic matter and sterilizes soils in the area of the fire-ring. The severity of the impacts is related to the intensity of the fire (Fenn et al. 1976).

In some low-productivity, high-elevation forest types, fuelwood regeneration does not keep pace with its utilization for campfires resulting in various types of impacts (Davilla 1979). Within the parks results from a woody surface-fuel inventory, sampling campsites in foxtail and lodgepole pine forest in the upper Kern River drainage between 10,400 feet and 11,200 feet, indicated inadequate fuelwood to sustain campfires in these areas (Atkinson et al. 1990). Elsewhere in the Sierra Nevada, Davilla (1979) reports

that wood litter production in whitebark pine forest was low compared to adjacent lodgepole pine and mountain hemlock forest.

In general, consumption exceeds productivity in high-elevation whitebark pine forests in the western United States that are popular destinations for visitors (Cole 1989b). Additional impacts may occur at these campsites when available dead and downed wood is limited and visitors resort to removing lower limbs from standing trees or snags for fuelwood (Cole 1989b).

Another feature of high-elevation, low-productivity sites is the occurrence of long-lived subalpine tree species that are valuable aesthetically and as paleo resources, both as living individuals and as remnant wood from trees that have died. Long-lived conifers frequently exist under adverse growing conditions at sites with low productivity (Schulman 1954) and typically accumulate remnant dead wood on the ground that can be much older than any living tree (frequently two or three times older). Remnant dead wood in these subalpine areas, while not actually fossilized, can be many thousands of years old, is an important source of information on past ecological or climatic dynamics, and a valuable resource for dendrochronologists. These resources can be adversely affected by localized site degradation in heavily used areas through the consumption of very old remnant wood for campfires as well as by direct damage to the old living trees.

High-elevation conifer forests within the parks are home to four long-lived conifer species (NPS 2007b) that can reach ages in excess of 1,000 years (Brown 1996). These conifers include three subalpine white pine species; whitebark pine, foxtail pine, and limber pine, as well as the upper montane Sierra juniper. Remnant wood from these species can survive for millennia due to a combination of a dry cool environment, rot resistant wood, and low forest turnover rates (Stephenson and van Mantgem 2005). Besides being on low productivity sites, these old trees and remnant wood are found at these high-elevation sites because the probability of natural fire is low (a combination of infrequent fire [Caprio and Swetnam 1995; Swetnam et al. 1998] and small average area burned annually [Caprio 2004]). As a result the probability of a tree being killed or dead wood being consumed by natural fire is much smaller than at the lower elevations.

Scuderi (1987) reported that radiocarbon-dated samples of dead wood from foxtail pine exceed 6,000 years in age. Because this remnant wood can survive for such long periods of time even extremely small impacts, such as burning as fuelwood or removal, compounded over long periods will have significant negative effects. Additionally, specific sites across the elevational gradient over which a species lives may have different scientific value so impacts will vary depending on location. For example, trees at the lower elevational limits of a species distribution are generally more sensitive to precipitation and so are valuable for extracting a record of past rainfall, whereas individuals respond to temperature at high elevations. At elevations above current treeline “ghost forests” of dead trees provide information on long-term changes in treeline due to changing climate over many thousands of years.

**Trampling:** Trampling impacts are mechanical damage to above or below ground plant parts. Trampling is caused by foot or hoof traffic, stock rolling and pawing, and camp activities. Trampling can reduce leaf area, plant height, and reproductive output (Liddle 1997). These impacts can result in decreased vigor or death of individual plants, changes in species composition, and loss of vegetation.

The relationship between trampling intensity and vegetation impact is curvilinear. The greatest total impacts on vegetation occur at low trampling intensities; additional trampling can continue to impact vegetation but at a lower rate (Cole 1987, Kuss and Hall 1991, Cole 1995a, Marion and Cole 1996, Cole and Spildie 1998). Trampling impacts from an individual horse or mule is 6–10 times greater than an individual hiker, largely due to the greater force applied (Weaver and Dale 1978, Cole and Spildie 1998). Slopes are more susceptible to trampling impacts than flat ground (Weaver and Dale 1978).

Vegetation types differ in their ability to resist and recover from trampling. Structural characteristics are important in determining which plant species are most resistant to trampling and how quickly they recover (Cole 1995b). The characteristics of grass-like plants make them more resistant to trampling impacts than forbs and woody plants such as shrubs and young trees (Cole 1993, Cole 1995b) and grassland and meadow vegetation may tolerate trampling better than the understory of wooded areas (Cole 1987, Cole and Monz 2002). However, meadow and riparian vegetation is especially susceptible to damage to above and below ground structures early in the growing season when soils are wet and plants are undeveloped (Trimble and Mendel 1995, Neuman 1996, McClaran et al. 2013).

In contrast to vascular plants, mosses have poorly developed systems for conducting water and nutrients, and are dependent on the availability of water for reproduction. As a consequence mosses are low-growing in stature and are frequently found in moist environments, although an ability to go into dormancy allows some mosses to inhabit seasonally dry habitats. Lacking a true root system, mosses are held in place by filamentous root-like structures and rely on taking in water directly wherever it comes in contact with the plant. Many mosses thus depend on the surface moisture readily available in wet meadows and fens, as well as along stream courses and in other wetland environments.

The lack of a root system and reliance on surface water availability makes some mosses vulnerable to ground disturbance, as they are unable to ‘spring back’ from a developed underground root system after being trampled. They are also vulnerable to changes in water temperature that may occur as a result of soil churning, which has potential consequences for their ability to photosynthesize at a rate commensurate with carbohydrate use (Powell et al. 2001). Some mosses, especially those that are relatively ephemeral, can respond positively to disturbance and are known to colonize disturbed soils.

Impacts on vegetation from trampling can persist for decades in mountain environments (e.g., Hartley 1999, Willard et al. 2007). Impacts on soils from trampling can have the most severe effect on vegetation. Soils may be compacted, which decreases water infiltration, gas exchange, and rooting of plants (Trimble and Mendel 1995) that can decrease plant cover and vigor. At high use levels, mechanical impacts on soils can result in erosion. In meadows, erosion can change the hydrological characteristics that determine local vegetation patterns (Allen-Diaz 1991). Lower water tables can cause the local loss of species that depend on high water tables resulting in a change from wetland vegetation to upland vegetation.

Actions that increase the amount of visitors will generally increase total trampling impacts. Actions that concentrate foot and stock travel to existing trails and routes, or concentrate campers in existing sites have the potential to decrease total impacts. Actions that move traffic and camps to less tolerant vegetation types or steeper slopes could increase impacts. Actions that affect stock users behavior have the potential to change trampling impacts more than those that affect hiker behavior on a per-capita basis; overall changes will be a function of the number of users affected. Actions that increase visitation early in the growing season have the potential to increase impacts.

Trampling of wetland and meadow vegetation by human traffic largely occurs along trails that pass through meadows, along riparian corridors and lakeshores where campers pass through for water or to fish, and where visitors set up camps on or adjacent to meadow or riparian vegetation.

**Grazing:** Grazing by stock impacts vegetation both through trampling (discussed above) and defoliation. Grazing has both direct impacts on individual plants and indirect impacts on vegetation composition, structure, and ecosystem processes (McClaran and Cole 1993).

Defoliation of individual plants results in a reduction of photosynthetic tissues. The loss of foliage to stock grazing can decrease plant productivity (Stohlgren et al. 1989, Cole et al. 2004) and plant cover (Olson-Rutz 1996a, Cole et al. 2004).

Horses, mules, burros and llamas are selective grazers. Under the low intensity typical of recreational grazing areas, forage availability within a meadow area generally exceeds demand giving stock a choice in where they graze (patch grazing, McClaran and Cole 1993). The horses and mules that make up most of the stock use in the parks strongly select for tender grass-like species (Olson-Rutz 1996a), even when these have already been grazed extensively (Fleurance et al. 2001). Selective grazing alters the balance of other species interactions, such as competition. Depending on the duration and intensity of grazing, this can lead to declines in the abundance of grass-like species and increases in the abundance of forbs. The establishment of shrubs or trees in meadows (e.g., Dull 1999, Berlow et al. 2002) and invasion of nonnative species (discussed separately) are special cases of compositional changes that can be promoted by grazing. Grazing animals redistribute biomass and nutrients (Blank et al. 2006) that may also have an indirect impact on vegetation by favoring some species over others.



**Stock grazing in Evolution Meadow.**

The magnitude of impacts depends largely on grazing intensity measured by how much herbage is removed. Utilization, the proportion of plant production grazed by stock, is a measure of intensity that is a good predictor of vegetation impacts (Cole et al. 2004). The total amount of grazing required to reach a given utilization increases with productivity. In mountain meadows, productivity decreases with elevation, decreases at extremes of moisture availability, and decreases with a greater proportion of early seral plant species (Ratliff 1985). All else being equal, the total amount of grazing that a meadow can tolerate before impacts occur is higher in larger meadows, at lower elevations, at intermediate moisture levels, and where there is a greater proportion of late seral species.

Decreases in productivity and plant cover have been reported to have a relationship with grazing intensity that is curvilinear (Olson-Rutz 1996b, McClaran 2000) but may be approximately linear within a limited range of intensity (Cole et al. 2004). Low intensity grazing may have no detectable impact on species

composition and bare ground in Sierra Nevada meadows (Hopkinson et al. 2012, Lee 2013). As grazing intensity increases, bare ground and productivity impacts may develop before changes to species composition (McClaran 2000, Cole et al. 2004). Interannual variation in snowpack may also interact with grazing intensity to determine impacts (Lee 2013). Grazing impacts occur within a growing season but may persist after grazing ends (Olson-Rutz 1996b, Cole et al. 2004).

Different kinds of vegetation may be sensitive to different grazing impacts. Dry meadows may be more susceptible to decreased productivity and losses of vegetation cover than wetter meadows (Cole et al. 2004, Lee 2013, but see Stohlgren et al. 1989). Moist meadows may be more susceptible to changes in species composition than wet or dry meadows (Cole et al. 2004).

Actions that increase the number of grazing stock will increase total grazing impacts. Actions that increase grazing intensity on a site increase the potential for productivity losses, loss of total vegetation cover, and compositional changes.

**Nonnative Plant Species:** The probability and success of nonnative plant establishment in the parks' wilderness is primarily dependent on two factors: disturbance and propagule pressure. Disturbances that reduce native plant cover and create bare soil allow nonnative plant species to take advantage of the newly available light, moisture, and nutrients and become established (Richardson and Pysek 2006). Nonnative plant establishment is most successful in the parks in areas of current and past natural and human-caused disturbance such as roads, trails, developed areas, stock corrals, recent fires, helicopter landing sites, camps, and riparian sites (Gerlach et al. 2003, Tu et al. 2013). To establish in a disturbed site, nonnative plant propagules (seeds or propagative root or stem fragments) need to be introduced to the site, and the more propagules that arrive, the more likely it is that nonnative plants will establish, even in undisturbed vegetation (Von Holle and Simberloff 2005). This principle is known as "propagule pressure." In the parks' wilderness, propagules can be moved by visitors and staff on hiking boots, gear, and clothing; by helicopter; by stock in fur, hooves, or manure; or by imported materials such as stock feeds, gravel, and equipment.

Where alternatives differ in the amount of disturbance or propagule pressure, they will have different probabilities of nonnative plant establishment. Alternatives that allow less stock grazing and less area open to stock travel would have lower-severity disturbance, less extensive disturbance, and lower propagule pressure. Alternatives that have lower quotas and smaller group sizes would decrease both propagule pressure and the severity of localized disturbance. Fewer maintained trails and ranger stations would decrease the extent of trail corridors and disturbed area available for nonnative plant introductions, but more importantly would decrease the administrative support activities (stock support; helicopter support; tools, supplies, and people moving between frontcountry and wilderness) that have the potential to move nonnative plant propagules.

While all recreational and administrative activities have the potential to increase the spread of nonnative species, those that create the most disturbance and carry the most propagules have the highest risk. Stock create more severe and extensive soil disturbance than do hikers (Weaver and Dale 1978). A variety of seeds have been found to germinate from horse manure (Quinn et al. 2008), including velvet grass (*Holcus lanatus*) (Cosyns et al. 2005), with peak passage of viable seed two to four days after ingestion (Vander Noot et al. 1967, St. John-Sweeting and Morris 1990). Equestrian trails and camps have been found to have more nonnative plants than those that do not allow horses (Campbell and Gibson 2001, Cole and Hall 1992, but see Marcus et al. 1998).

While studies of mid- to high-elevation Sierra meadows suggest that significant nonnative plant invasions may be rare (D'Antonio et al. 2004, Hopkinson et al. 2013), where they do occur they can displace native wetland plants and require significant resources to control. The most ecologically disruptive and costly

invasive plant infestations to manage in recent years have been perennial grass infestations in mid-elevation meadows, such as velvet grass infestations on the floor of the Kern Canyon. These infestations were likely caused by an intersection of factors that favor nonnative plant establishment: mid-elevation wetlands (approximately 7,000 feet and below), high stock use (including trail crew and ranger stock), and propagule pressure (adjacent sources of invasive plants). In the last decade, parks staff have detected several other nonnative perennial grasses in mid-elevation wilderness meadows that are causing or have the potential to cause significant ecological impacts, including reed canarygrass (*Phalaris arundinacea*) and smooth brome (*Bromus inermis*) in Sugarloaf Meadow and orchard grass (*Dactylis glomerata*) in meadows and moist locations in LeConte Canyon, Palisade Creek, and Bubbs Creek. These are all common pasture grasses. Alternatives that restrict stock travel to trails and that do not allow (or reduce) grazing in meadows will decrease the probability that this suite of invasive perennial grasses will become established in mid-elevation wilderness meadows.

Measures to reduce disturbance and prevent the introduction of nonnative plant propagules will never be 100% successful. To protect native ecosystems, new introductions need to be detected early and eradicated before they establish a large seed bank and develop into large infestations. The probability of detection is higher along trail corridors and in established campsites than in off-trail areas and in meadows. Therefore, the chance of detecting and eradicating new introductions of invasive, nonnative plants early is higher in alternatives that restrict stock travel to trails and that prohibit (or reduce) grazing in meadows. Similarly, alternatives that restrict stock travel to trails and that prohibit (or reduce) grazing in meadows will decrease the probability that invasive perennial grasses will become established in mid-elevation wilderness meadows.

## **FACTORS THAT CONTRIBUTE TO VEGETATION IMPACTS**

The primary factors that contribute to vegetation impacts include trampling from hikers, backpackers, and stock (from either recreational or administrative sources), grazing by stock, nutrient loading from human and stock waste, the introduction of nonnative invasive plant species by hikers and stock, the collection of firewood for campfires, and the creation or maintenance of infrastructure that supports visitor recreation (trails, campsites, ranger stations, food-storage boxes, etc.).

All mitigation measures and best management practices related to the protection of soils and water would also protect vegetation in the parks, as those measures would work to reduce or eliminate impacts on vegetation. These mitigation measures and best management practices are common to all action alternatives. The impact intensity of each alternative assumes employment of the mitigation measures and best management practices, as they are considered components of the alternatives.

Appendix D presents the parks' proposed strategy for monitoring and managing stock use in wilderness, which includes an overview of monitoring protocols and management tools focused on detecting changes and minimizing impacts associated with the use of recreational and administrative stock.

Appendix N presents the parks' prevention, early detection, and rapid response strategy to protect native ecosystems from invasive nonnative plants.

Where impacts on populations of plants of conservation concern are detected, actions are taken to redirect or shift use to protect the plants at risk. Documenting locations of plants of conservation concern and noting and mitigating impacts is an integral part of conducting plant surveys and monitoring of hiker and stock impacts in wilderness.

## **IMPACTS COMMON TO ALL ALTERNATIVES**

All of the actions that would contribute to vegetation impacts are common to all alternatives, with the exception of stock grazing, which would be prohibited under alternative 4. Thus there would be little

change in the impacts on vegetation, but there could be increases or decreases in the intensity and magnitude of the impacts across the alternatives.

**IMPACTS OF ALTERNATIVE 1: NO-ACTION / STATUS QUO**

**Wetlands and Meadows:** Trampling of wetland and meadow vegetation by human traffic would continue to occur along trails that pass through meadows, along riparian corridors and lakeshores where campers pass through for water or to fish, and where visitors set up camps on or adjacent to meadow or riparian vegetation. While these impacts can be locally severe, they are currently insignificant at the landscape scale and this would be expected to remain the case. If visitation increases in certain destinations (as periodically occurs in response to news articles, guidebooks, and information shared through social media) local trampling impacts could increase. The development of informal trails would continue to pose potential risks to adjacent wetlands, which would be mitigated through visitor education, trail reroutes, or restoration.

Trampling and grazing of wetland and meadow vegetation by administrative and recreational stock would continue. Stock access and grazing would continue to be managed and monitored according to the 1986 SUMMP and BMP.

Stock would continue to be allowed in the wilderness of the parks on trails and in areas where they are currently permitted under the 1986 SUMMP and BMP, including the four cross-country stock areas (Hockett, Monarch Divide, Roaring River, and portions of the Kern Canyon).

Individual meadows would continue to be closed to grazing or have night, head or use level restrictions imposed under the Superintendent’s authority to impose temporary restrictions on visitor use in order to protect sensitive resources.

Parties traveling with stock would continue to have access to up to 64% of the meadow area in the parks, with 51% of all meadows open to grazing. The meadows that would remain open to grazing contain 70% of the peat-accumulating meadow area and 42% of lakeshore meadow length. Up to 46% of lacustrine features, 76% of palustrine features, 97% of riverine features, and 64% of all wetland features are in areas that would remain open to stock travel. Within the area open to stock access, up to 46% of lacustrine features, 64% of palustrine features, 81% of riverine features, and up to 51% of all wetland features are in areas open to grazing.

**Table 77: Alternative 1 – Values are Percentages of Row (Meadow Type) Totals**

<b>Meadow Type</b>	<b>Open to Stock Access; Open to Grazing</b>	<b>Open to Stock Access; Closed to Grazing</b>	<b>Closed to Stock Access</b>
Fen	81%	9%	10%
Fen/wet meadow	73%	17%	10%
Wet meadow	55%	15%	30%
Moist meadow	42%	10%	48%
Dry meadow	48%	12%	39%
All meadow types	51%	13%	36%
Peat-accumulating area	70%	21%	8%
Lakeshore meadow	42%	10%	48%

**Table 78: Alternative 1 – Values are Percentages of Row (System) Totals for Each Kind of Wetland Feature (Linear or Area)**

System	Open to Stock Access Open to Grazing		Open to Stock Access Closed to Grazing		Closed to Stock Access	
	Linear	Area	Linear	Area	Linear	Area
Lacustrine	46%	29%	0%	12%	54%	59%
Palustrine	45%	64%	12%	12%	43%	24%
Riverine	49%	81%	16%	16%	35%	3%
<b>Total</b>	<b>48%</b>	<b>51%</b>	<b>14%</b>	<b>12%</b>	<b>38%</b>	<b>36%</b>

Although technically open to stock travel and grazing, much of the wetland and meadow area is inaccessible to stock parties and thus stock use would continue to be concentrated in named forage areas adjacent to maintained trails. Grazing, trampling, and non-native species impacts to wetland and meadow vegetation outside of named forage areas would continue to be rare and of light intensity; therefore grazing and trampling impacts to wetland and meadow vegetation outside of named forage areas would be negligible.

Capacities, night and head limits, and other tools would continue to be used to manage the intensity of grazing impacts. Utilization values of 30–40% would be used to estimate default grazing capacities, which would be modified where monitoring data provides additional information.

In any given year, a relatively small subset of all popular meadows would have grazing limits — based on estimated capacities — imposed through the superintendent’s compendium. Actual utilization levels would reflect annual stock use patterns and productivity, which varies from year to year in response to both weather and use levels.

Administrative use of stock would likely remain at current levels and would occur in the same areas as the level of trail development and maintenance would not change. Commercial stock use could continue at current levels, but may decline or increase in response to socioeconomic drivers. Private use would likely continue at current levels or could continue to decline. Therefore, overnight stock use in the parks would be expected to remain similar to the 10-year average of 6,775 stock nights.

Grazing levels would likely continue to be similar to the 10-year average of 6,058 stock nights. If the increasing trend in the use of supplemental feed continued, there could be a slight overall reduction in grazing and thus in grazing and trampling impacts on meadows and wetlands.

Past use levels in named forage areas provide an estimate of grazing impacts under alternative 1 (tables 79 and 80 below). Grazing would likely continue to occur in approximately 43% of the meadow area open to grazing.



**Table 79: Number and Meadow Area in Lower Montane and Woodland Forage Areas Grazed at Three Utilization Levels\***

Alternative 1	Estimated utilization Moist <35% Dry or Wet <25%		Estimated utilization Moist 35–45% Dry or Wet 25–35%		Estimated utilization Moist >45% Dry or Wet >35%	
	Number of Forage Areas	Forage Area Acres	Number of Forage Areas	Forage Area Acres	Number of Forage Areas	Forage Area Acres
Lower Montane & Woodland	52	274	2	11	8	42

\*based on 2008–2012 stock use data and modeled productivity values

In 52 lower montane forage areas (totaling 274 acres) estimated utilization would likely continue to be less than 35% in moist meadows, or less than 25% in dry or wet meadows (and less than 10% in 44 forage areas with an area of 209 acres). The amount of foliage left ungrazed at these levels would be greater than the amount of herbage which would be expected to decompose annually; productivity would be expected to be similar to comparable ungrazed meadow vegetation.

In two lower montane forage areas (totaling 11 acres) utilization would likely continue to be 35–45% in moist meadows or 25–35% in dry or wet meadows. The amount of foliage left ungrazed at these levels would be approximately equal or slightly more than the amount of herbage which would be expected to decompose annually; productivity would be expected to be similar to comparable to ungrazed meadow vegetation.

In nine lower montane forage areas (totaling 42 acres) estimated utilization would likely continue to be greater than 45% in moist meadows and greater than 35% in dry or wet meadows. The amount of foliage left ungrazed at these levels would be less than the amount of herbage which would be expected to decompose annually; productivity would be expected to be lower than comparable ungrazed meadow vegetation.

**Table 80: Number and Meadow Area in Upper Montane and Subalpine Forage Areas Grazed at Three Utilization Levels\***

Alternative 1	Estimated utilization <25%		Estimated utilization 25–35%		Estimated utilization >35%	
	Number of Forage Areas	Forage Area Acres	Number of Forage Areas	Forage Area Acres	Number of Forage Areas	Forage Area Acres
Upper Montane and Subalpine	168	5858	13	264	8	123

\*based on 2008–2012 stock use data and modeled productivity values

In 168 upper montane and subalpine forage areas (totaling 5858 acres), estimated utilization would likely continue to be less than 25% (and less than 10% in 144 forage areas with an area of 5501 acres). Utilization less than 25% in dry *Carex filifolia* vegetation would, on average, increase productivity by 2% or more and increase basal vegetation cover by 7% or more relative to ungrazed vegetation. In moist to wet *Deschampsia cespitosa* vegetation, utilization less than 25% would, on average, decrease productivity by less than 11% relative to ungrazed vegetation. Utilization less than 25% in moist *Calamagrostis muiriana* vegetation would, on average, reduce productivity by less than 10%, increase basal vegetation

cover by more than 41%, and decrease relative graminoid cover by less than 6% relative to ungrazed vegetation.

In 13 upper montane and subalpine forage areas (totaling 264 acres), estimated utilization would likely continue to be between 25% and 35%. This level of utilization in dry *Carex filifolia* vegetation would, on average, change productivity by +2 to -10% and change basal vegetation cover by +7 to -16% relative to ungrazed vegetation. In moist to wet *Deschampsia cespitosa* vegetation, this level of utilization would, on average, reduce productivity by 11–18% relative to ungrazed vegetation. This level of utilization in moist *Calamagrostis muiriana* vegetation would, on average, reduce productivity by 10–16%, increase basal vegetation cover by 14–41%, and decrease relative graminoid cover by 6–12% relative to ungrazed vegetation.

In eight upper montane and subalpine forage areas (totaling 124 acres), estimated utilization would likely continue to be greater than 35%. This level of utilization in dry *Carex filifolia* vegetation would, on average, reduce productivity by more than 10% and reduce basal vegetation cover by more than 16% relative to ungrazed vegetation. In moist to wet *Deschampsia cespitosa* vegetation, this level of utilization would, on average, reduce productivity by more than 18% relative to ungrazed vegetation. This level of utilization in moist *Calamagrostis muiriana* vegetation would, on average, reduce productivity by more than 16%, increase basal vegetation cover by less than 14%, and decrease relative graminoid cover by more than 12% relative to ungrazed vegetation.

Because horses and mules are selective grazers and overall grazing pressure is light, grazing impacts would generally be concentrated in one meadow vegetation type within a forage area. Grazing capacities would be based on the area of this preferred vegetation, which is usually less than the area of the entire meadow; therefore, the extent of the most severe predicted impacts to meadow and wetland vegetation would be less than the total meadow area summarized above.

Trampling impacts on meadows would be directly related to grazing, since stock travel through meadows open to access but closed to grazing would continue to be uncommon and infrequent. The timing of grazing would continue to be controlled by a system of opening dates tied to soil moisture and meadow conditions, which would reduce stock-related impacts in wetlands such as deep hoofprints, which are more likely to occur early in the season when soils are wet.

Potential nonnative species introductions would be proportional to the meadow area open to both access and grazing, as species deposited along trails and in camps may be propagule sources for wetlands and meadows. Surveys to provide for the early detection of nonnative species would be conducted as part of routine meadow monitoring and wilderness patrol activities.

Grazing and trampling impacts would continue to be highest in popular meadows along the JMT corridor, in traditional destinations for visitors traveling with stock (such as Roaring River and Hockett Plateau), and in areas serving as foci for trail maintenance and construction crews. Some meadows, such as those in popular destinations such as the Crabtree, Evolution, Hockett, LeConte, Roaring River, and Rock Creek areas, would continue to be periodically closed to access or grazing as needed to meet resource protection needs. Management of grazing levels in the most popular destinations would continue to be informed by site-specific grazing capacities based on the guidelines for utilization levels proposed by Ratliff (1985) and modified to reflect local resource concerns. Such limits would not necessarily be placed on all meadows open to grazing in the surrounding areas; thus, use could shift to nearby meadows which could then lead to an increase in impacts associated with increased grazing pressure. Such impacts may go undetected until the end of the season, in some cases resulting in a delay in management response until the following year. Shifts in use could also result in increased grazing of peat-accumulating wetlands that

are otherwise not preferred by stock, and a potential increase in impacts on the integrity of peat forming vegetation.

Under alternative 1, the overall extent and severity of trampling, grazing, and nonnative species impacts on meadows and wetlands would be expected to remain comparable to current levels. Any significant increase in levels of use or change in patterns of use would be expected to result in increased trampling and/or grazing impacts. These would continue to be detected and mitigated through implementation of the 1986 SUMMP and BMP and routine monitoring by wilderness ranger and meadow monitoring staff. The current monitoring system established by the SUMMP would continue to be employed to track use, document conditions, and provide information for preventing and mitigating impacts. Where monitoring and site assessment indicate a need for a change in use levels or patterns to protect wetland structure or function, management actions including visitor education, local restrictions, or temporary closures would be taken.

**High-elevation Long-lived Tree Species:** Campfire restrictions in wilderness would continue to range from 9,000 feet in the Kaweah, Tule, and Soda Springs drainages to 10,400 feet in the Kern River drainage, while remaining at 10,000 feet for the Kings and San Joaquin River drainages. In addition, there would continue to be site-specific restrictions in the Kings (Granite Basin and Redwood Canyon), Kaweah (Hamilton Lakes and Mineral King Valley), Kern (above 10,000 feet in Nine Lakes Basin/Big Arroyo, and within 0.25 miles of the food-storage box at Lower Crabtree Meadow), and Tule River (Summit Lake basin and Dillonwood area) drainages. This would limit some impacts on old living trees, the collection of downed wood, and additional trampling from the collection of firewood.

Alternative 1 includes the greatest acreage of high-elevation forest without campfire restrictions where foxtail pine, whitebark pine, limber pine, and Sierra juniper forests exist. Recreational campfires would be restricted in 439,515 total acres of the parks. In wilderness areas of the parks, campfires would be permitted in 44,212 acres of high-elevation conifer habitat that supports the four subalpine long-lived tree species. Considering just the three five-needle conifers (whitebark pine, foxtail pine, and limber pine), this area would be 24,332 acres.

In areas without restrictions, the potential for impacts to the four species exists from campfires and fuelwood gathering. The area of greatest potential for impacts is 1,893 acres around campsites and trails, based on a buffer of 328 feet, the area in which a majority of wilderness visitors are most likely to collect firewood.

The current campfire restrictions also protect the higher-elevation habitat of non-target vegetation classes, which includes portions of the distribution of species such as lodgepole pine (*P. contorta*) and mountain hemlock (*Tsuga mertensiana*). In the Kaweah River drainage, with restriction starting at 9,000 feet, this would include some western white pine (*P. monticola*), and red fir (*Abies magnifica*) forest as well. Under current regulations this area is approximately 49,262 acres.

**Alpine Vegetation:** Most of the alpine vegetation in the parks – found in some of the most remote and inaccessible portions of wilderness – is thought to be intact and relatively free from human disturbance. Where visitor use is concentrated, however, the slow-growing, perennial-dominated communities that make up the alpine vegetation can show signs of impact. Due to the short growing season and harsh conditions that characterize the high-elevation environment, recovery from even minor disturbances can take a very long time and impacts can persist.

Direct removal of alpine vegetation occurs infrequently, and is primarily associated with trail maintenance and construction activities. Under this alternative, impacts resulting from these activities would continue at existing levels, resulting in localized impacts on alpine plants.

Trampling of alpine vegetation along trail corridors and in high-elevation camp areas by human traffic would continue to occur. While these impacts can be locally severe, they are currently insignificant at the ecosystem or landscape scale and this would be expected to remain the case.

Most trampling impacts would continue to occur along cross-country routes and in popular destinations where visitor use is concentrated. Areas where such impacts would be expected to continue to be seen would include Dusy Basin, the Mount Whitney area, Upper Darwin Canyon/Lamark Col, Mount Langley, Kearsarge Lakes, and other similar high-elevation basins and routes popular with hikers. However, should other destinations increase in popularity (as periodically occurs in response to news articles, guidebooks, and information shared through social media) local trampling impacts in such areas would be expected to increase. With an anticipated increase in visitation to the Mount Whitney area, trampling impacts on alpine vegetation would be expected to increase along all routes leading into and through the area, especially through Miter Basin, Crabtree Pass, and along the JMT corridor. Increased popularity of Mount Langley, as an easily accessed 14,000+ foot peak, would continue to result in impacts on the sparsely vegetated summit area and along the multiple approach routes; however, these are expected to be mitigated soon by the establishment of a cairned route to the summit. Similarly, the increased popularity of alpine summits along the crest among ‘peak baggers’ would be expected to lead to increased development of informal trails and trampling of alpine vegetation, both on the summits and along approach routes.

Stock would continue to be allowed in the wilderness of the parks on the same areas and trails, including the four cross-country stock areas (Hockett, Monarch Divide, Roaring River, and portions of Kern Canyon). Under the regulations established by these plans, 64% of the mapped alpine vegetation in the parks (including alpine meadows, which are also considered under wetland and meadows above) would remain closed to access by stock; 30% would remain open to stock access and grazing, with the remaining 6% open to access but closed to grazing. Trampling impacts on upland alpine vegetation would continue to be largely associated with established trails and routes, since cross-country stock travel through alpine areas is infrequent. In the alpine areas open to overnight use by stock but closed to grazing, such as Dusy Basin and in the Mineral King lake basins, occasional use would be expected to continue with resulting localized trampling and incidental grazing impacts on alpine vegetation. These impacts would be limited to camp areas within 0.5 mile of the trail corridor.

In the alpine meadows, trampling impacts would continue to be associated with grazing, as cross-country travel in these areas is largely restricted and infrequent. The timing of grazing would continue to be controlled by a system of opening dates tied to meadow conditions; these would continue to reduce stock-related impacts such as deep hoof prints, which are more likely to occur early in the season when soils are wet.

Grazing of upland alpine vegetation would continue to occur primarily in the drier meadow types such as the Wright Creek meadow complex along the JMT, in the meadows of the headwaters of the Kern, in the meadows of upper Big Arroyo and Lost Canyon, and in Upper Basin. Grazing of wet alpine meadows would be expected to continue to occur sporadically in individual meadows along the JMT, including in the Twin Lakes and Palisade Lakes basins, and also in the lower Miter Basin area. Grazing of other alpine vegetation types, such as fell-fields, would be infrequent and associated with pass-through travel and in areas where stock can be held and fed but not grazed.

Administrative use of stock would likely remain at current levels and would occur in the same areas as the level of trail development and maintenance would not change. Free-roaming stock used to support trail maintenance activities would continue to graze alpine vegetation in the meadows of the headwaters of the Kern and in Sheep Camp Meadows (north and east of the Tyndall Ranger Station). Under current use levels and patterns, grazing by commercial-outfitter stock would be expected to continue to occur on a

regular basis in the alpine uplands of the Wright Creek drainage, in the meadows of the headwaters of the Kern, and occasionally in the Taboose Pass, Woods Lake, Lower Miter Basin, and Siberian Outpost areas. Private grazing of alpine areas would be expected to remain infrequent and at very low intensities.

Grazing of alpine vegetation in the Evolution Lake basin would continue to be restricted to walking parties with burros or llamas. Because these animals have unshorn hooves, consume less forage than horses or mules, and are infrequently used as stock in the parks, trampling and grazing impacts on alpine vegetation would continue to be minimal in this area.

Under current use levels and patterns, vegetation in untrailed alpine areas would remain largely undisturbed. Any significant increase in levels of use or change in patterns of visitor use would be expected to result in increased trampling and/or grazing impacts on alpine vegetation.

**Plants of Conservation Concern (Park Sensitive Plant Species):** Direct removal of plants of conservation concern would be expected to occur only under very limited circumstances, such as collections made in the course of research, inventory, or monitoring activities. Collection of voucher specimens is strictly regulated through the research permitting and environmental compliance processes to prevent population level impacts. Because the species of concern are by definition rare, the likelihood that they would be encountered by visitors and illegally collected is considered quite low. This would be expected to remain the case under all of the alternatives.

Similarly, trampling of the plants of conservation concern by hikers would be expected to be infrequent under current levels and patterns of use. Although species in the meadows and uplands may suffer incidental trampling by visitors traveling through meadows or on cross-country routes, this would not be expected to result in population level impacts.

Vascular plant species of conservation concern known or suspected to occur in alpine upland areas frequented by cross-country hikers and used occasionally by stock include the following:

- Beautiful pussy-toes (*Antennaria pulchella*)
- Raven's milkvetch (*Astragalus ravenii*)
- Truckee cryptantha (*Cryptantha glomeriflora*)
- Tulare County bleeding heart (*Dicentra nevadensis*)
- Mount Whitney draba (*Draba sharsmithii*)
- Bog stitchwort (*Minuartia stricta*)
- Alpine jewelflower (*Streptanthus gracilis*)

At current visitor-use levels, impacts on these species would be expected to remain infrequent and insignificant at the population level.

If current levels and patterns of recreational rock climbing on the walls of the South Fork Kings River were to continue, incidental impacts on individuals of marble rockmat (*Petrophyton caespitosum*), which grows in crevices and on ledges in the canyon, would be expected to occur. If the area increased in popularity as a climbing destination, with a subsequent increase in the use of existing routes and the development of additional new routes, these impacts could become locally significant and could have measurable impacts on local populations. As the species is also found in remote, off-trail areas not favored by climbers, such impacts would not be expected to result in large-scale losses or declines that could lead to the listing of the species.

Species known or suspected to inhabit areas that are open to cross-country travel by stock include Tulare County bleeding heart (*Dicentra nevadensis*), field ivesia (*Ivesia campestris*), Hockett Meadows lupine (*Lupinus lepidus* var. *culbertsonii*), purple mountain-parsley (*Oreonana purpurascens*), Tulare County rock cress (*Boechera pygmaea*), and Sierra Nevada linanthus (*Leptosiphon oblanceolatus*). As cross-country travel by stock is in general a rare and infrequent occurrence, under current use levels and patterns impacts would be expected to be localized and insignificant at the population level.

Exceptions to this are found along the floor of the lower Kern Canyon, where administrative grazing of the area known as the ‘maze’ coincides with the habitat of Kern River daisy (*Erigeron multiceps*), and on the Hockett Plateau, where administrative stock tend to roam off trail and can potentially encounter populations of Tulare County bleeding heart (*Dicentra nevadensis*), field ivesia (*Ivesia campestris*), Hockett Meadows lupine (*Lupinus lepidus* var. *culbertsonii*), and purple mountain-parsley (*Oreonana purpurascens*). Based on recent surveys, current use levels and patterns do not appear to be resulting in population level impacts on these species.

Vascular plant species of conservation concern either known to, or having the potential to, inhabit areas in or adjacent to meadows open to grazing by stock include the following:

- mountain bent grass (*Agrostis humilis*)
- beautiful pussy-toes (*Antennaria pulchella*)
- Tulare County rock cress (*Boechera pygmaea*)
- Mingan moonwort (*Botrychium minganense*)
- meadow sedge (*Carex praticola*)
- Bolander’s woodreed (*Cinna bolanderi*)
- marsh claytonia (*Claytonia palustris*)
- Tulare County bleeding heart (*Dicentra nevadensis*)
- Mount Whitney draba (*Draba sharsmithii*)
- Oregon fireweed (*Epilobium oreganum*)
- copper-flowered bird’s foot trefoil (*Hosackia oblongifolia* var. *cuprea*)
- field ivesia (*Ivesia campestris*)
- Sierra Nevada linanthus (*Leptosiphon oblanceolatus*)
- Hockett Meadows lupine (*Lupinus lepidus* var. *culbertsonii*)
- purple mountain-parsley (*Oreonana purpurascens*)
- rayless mountain butterweed (*Packera indecora*)
- marsh arrow-grass (*Triglochin palustris*)
- alpine jewelflower (*Streptanthus gracilis*)

Based on recent site assessments, impacts on these species are not resulting in large-scale losses or declines that could lead to the listing of any of the species. Under current use levels and patterns, this would be expected to remain the case.

*Mosses* – The mosses of concern considered in this analysis (*Bruchia bolanderi*, *Helodium blandowii*, *Meesia triquetra*, *Meesia uliginosa*, and *Pohlia tundrae*) all exist in meadow environments. One of these species, *Bruchia bolanderi*, responds positively to disturbance. This species has a short ephemeral life cycle, with spores germinating in the fall and winter, maturing in early spring, and withering by midsummer. *B. bolanderi* thus does well in areas with exposed moist soil and is considered a pioneer species. Under current levels of use, *B. bolanderi* may respond positively to localized trampling by hikers in the moist alpine areas of Dusy Basin, which is currently the only known location for this species in the parks.

Of the remaining four moss species of concern, only *Helodium blandowii* is known to grow in meadows that are open to grazing; this moss has been documented in two meadows in LeConte Canyon. As stock do not trespass into the wettest portions of the fen complex at Big Pete supporting *H. blandowii* unless the forage in the wet meadow area is exhausted, impacts are controlled by limiting the total number of nights available for grazing. When trampling impacts have been observed in the fen portions of the meadow and associated forested fen, additional controls have been put in place through the adaptive management program. Under the no-action alternative, trampling impacts in Big Pete Meadow would continue to be mitigated in this way.

Currently the two species of *Meesia* are known only from two mid-elevation peat-accumulating meadows in the Kaweah River drainage that are not open to stock access or grazing. It is likely that additional occurrences will be documented in other peat-accumulating wetlands as knowledge of mosses and their distribution increases. Any increase in use of peat-accumulating wetlands by stock would thus have the potential to impact these species.

The remaining moss of concern, tundra thread moss (*Pohlia tundrae*), has been documented from a single location in Sequoia National Park in the Upper Miter Basin area. As this basin is expected to remain a popular access route into the Mount Whitney area, the wet meadows that support *P. tundrae* would remain susceptible to trampling impacts by cross-country travelers. Increased use of this area has led to increased trail impacts, resulting in temporary party size restrictions for cross-country travelers in the Miter Basin. As use of this area by stock would continue to be limited to day rides and pass through, impacts on this species from stock would only be expected in the rare incidences when stock left the trail corridor.

**Nonnative Plant Species:** Current levels of stock use, visitor use, and facility maintenance would be expected to continue; related disturbance and propagule pressure would continue to promote introduction and establishment of new nonnative plant populations; and susceptible ecosystems, such as mid-elevation meadows, would continue to receive stock use. While off-trail travel by stock is very infrequent, off-trail stock travel and grazing would be allowed in four areas, continuing the potential for introducing nonnative plants in areas where early detection would be difficult and costly.

Current mid-elevation meadows open for grazing would continue to be open for grazing, continuing the potential for invasive perennial grasses to establish. In these areas, the threat of plants similar to velvet grass being introduced and becoming established would continue.

Future infestations may not be as large as the velvet grass infestation in the Kern Canyon, since the parks now have a more strategic invasive plant management program and are conducting early detection for new introductions of invasive plants in vulnerable areas. Under alternative 1, the area requiring early detection surveys is highest of all the alternatives.

Unprocessed hay and hay cubes, which have a high chance of carrying viable seeds of both invasive plants and pasture grasses, would continue to be allowed to be carried into wilderness, with certified

weed-free feed recommended but not required. In addition to the more widespread nonnative perennial grass infestations listed previously, smaller introductions associated with hay and hay cube use at hitch rails and stock camps have been frequent at Redwood Meadow (6,000 feet elevation) and in upper Rock Creek (10,600 feet elevation). Nonnative plants found in these two locations include wild oat (*Avena fatua*), ripgut brome (*Bromus diandrus*), soft chess (*Bromus hordeaceus*), cheatgrass (*Bromus tectorum*), bull thistle (*Cirsium vulgare*), long-beaked filaree (*Erodium botrys*), barley (*Hordeum murinum*), common mallow (*Malva neglecta*), and annual bluegrass (*Poa annua*). Such introductions would likely continue in these and other areas due to use of seed-containing hay products.

**Cumulative Effects:** Other than those ongoing projects and activities associated with the administration of wilderness (i.e., facility and visitor-use management), there are few past, present, or future foreseeable projects in the parks' wilderness that have a detectable effect on vegetation.

The Fire and Fuels Management Program, guided by the *Fire and Fuels Management Plan* completed in 2003, directs management of fires in these parks. The plan supports the use of prescribed fires, allowing fires to burn, suppression where necessary, and follow-up restoration actions. The goals of fire use are to restore and maintain ecosystems, reduce hazard fuels, protect natural and cultural resources, and protect wildland/ urban-interface communities. Fire suppression actions can lead to direct impacts to vegetation, and in the long term the suppression of fire as an ecosystem process can have significant effects on the structure and composition of native vegetation. The actions proposed by this WSP/DEIS would not be expected to interact in any significant way with the potential effects of fire management/suppression activities under the Fire and Fuels Management Program.

The projects that may affect vegetation that are separate from projects proposed by this WSP/DEIS include the high-elevation forest monitoring and wetland monitoring programs, the Halstead and Cahoon meadow restorations, the ecological restoration program, invasive species management plan and activities, and permitted research activities. The high-elevation forest monitoring program works to quantify the current conditions of high-elevation forests in Sequoia, Kings Canyon, and Yosemite national parks. The project is not invasive and the results are beneficial, as it will provide information pertinent to conservation planning. The wetland monitoring program is minimally invasive and will provide information on the structure and function of wetlands that can serve as a reference against which to compare the condition of grazed meadows. The Halstead and Cahoon meadows are two severely impacted meadows in Sequoia National Park. The restoration plans work to recreate natural conditions at the meadows, which will provide a beneficial effect on the native vegetation communities. The invasive management plan includes control, survey, monitoring, treatment, preventive measures, and data management in regards to invasive plant species. Efforts to control invasive species could temporarily impact native vegetation, but the long-term impacts would be beneficial, as they would work to retain natural vegetation communities. Permitted research activities throughout wilderness cover a variety of resources, including vegetation. One of the most frequent topics for research in wilderness in the past three years has been vascular plants/plant communities. Research projects may temporarily disturb vegetation depending on the type of research and the methods of data collecting, but overall, the knowledge gained would be beneficial and could be applied to vegetation management plans.

Since alternative 1 proposed no changes to the management of native or invasive vegetation in wilderness, there would be no significant cumulative impacts associated with the alternative.



## IMPACTS OF ALTERNATIVE 2: PROTECT WILDERNESS CHARACTER BY IMPLEMENTING SITE-SPECIFIC ACTIONS (NPS PREFERRED ALTERNATIVE)

**Wetlands and Meadows:** Trampling of wetland and meadow vegetation by human traffic would continue to occur along trails that pass through meadows, along riparian corridors and lakeshores where campers pass through for water or to fish, and where visitors set up camps on or adjacent to meadow or riparian vegetation. While these impacts can be locally severe, they are currently insignificant at the landscape scale and this would be expected to remain the case. If visitation increases in certain destinations (as periodically occurs in response to news articles, guidebooks, and information shared



**Meadow, stream, and trees.**

through social media) local trampling impacts could increase. The development of such informal trails would continue to pose potential risks to adjacent wetlands, which would be mitigated through visitor education, trail reroutes, or restoration.

Trampling and grazing of wetland and meadow vegetation by administrative and recreational stock would continue. Stock access and grazing would be managed according to the Stock Use and Meadow Monitoring and Management Strategy described in appendix D.

The trail network would be expanded as some informal and abandoned trails are added to the maintained trail system. A few maintained trails would be closed to parties with stock. The number of trails where stock parties would be limited to day use would increase. In areas open only to day use by stock parties, travel would be limited to within 100 yards of maintained trails. Stock parties would be prohibited from traveling on routes which are not maintained, except in the four areas of the park where cross-country travel with stock would continue to be allowed. Off-trail travel by stock would no longer be allowed in the

lower Big Arroyo, providing additional protection from trampling and grazing impacts on the wet meadows and peat-accumulating wetlands there.

Taken together, these actions would reduce the percentage of meadow area which is open to some form of stock travel and thus subject to trampling impacts from 64% to 54%.

The following additional locations which are otherwise open to overnight stock use would be closed to grazing: Crabtree Lakes (closed to stock access and grazing above existing camp west of lowest lake), Darwin Meadow proper, Forester Lake Meadow, Guyot Creek Meadows (expanding the existing closure to the meadows east of the trail), Kern Hot Spring Meadow, Kettle Dome Meadows, Lake South America loop, Mineral King basin, Summit Lake Meadow, Upper LeConte Canyon above 10,000-foot elevation, Whitney Creek drainage above the Crabtree Ranger Station, and the Woods Lake basin (expanding the existing closure to the entire basin). Expansion of the grazing closure of Guyot Creek Meadows would protect the steep, peat-accumulating wetlands there from both trampling and grazing impacts.

Meadows in the areas newly closed to stock travel or only open to day use by stock parties under this alternative would also be closed to grazing. Grazing would continue to be allowed in most areas open to overnight stock use, although six meadows (Bighorn Plateau and the meadows south of Bighorn Plateau and west of the JMT and north of Wright Creek; Chagoopa Plateau #3 Meadow; Darwin Meadow; Grouse Meadow; Lower Crabtree Meadow; and Taboose Pass Meadow) would be closed to grazing for visitor experience and specific resource protection needs.

Overall, the percentage of park meadow area open to grazing would be reduced from 51% to 46%, which would reduce the percentage of peat-accumulating meadow area open to grazing from 70% to 67% and reduce the percentage of lakeshore meadow open to grazing from 42% to 35%.

Up to 46% of lacustrine features, 67% of palustrine features, 90% of riverine features, and up to 55% of all wetland features are in areas open to stock travel. Within the area open to stock travel, up to 46% of lacustrine features, 59% of palustrine features, 81% of riverine features, and up to 47% of all wetland features are in areas open to grazing.

**Table 81: Alternative 2 – Values are Percentages of Row (Meadow Type) Totals**

Meadow Type	Open to Stock Access; Open to Grazing	Open to Stock Access; Closed to Grazing	Closed to Stock Access
Fen	75%	9%	16%
Fen/wet meadow	67%	17%	16%
Wet meadow	51%	8%	41%
Moist meadow	37%	6%	57%
Dry meadow	40%	9%	51%
All meadow types	46%	8%	46%
Peat-accumulating area	67%	18%	15%
Lakeshore meadow	34%	8%	57%

**Table 82: Alternative 2 – Values are Percentages of Row (System) Totals for Each Kind of Wetland Feature (Linear or Area)**

System	Open to Stock Access; Open to Grazing		Open to Stock Access; Closed to Grazing		Closed to Stock Access	
	Linear	Area	Linear	Area	Linear	Area
Lacustrine	46%	24%	0%	7%	54%	68%
Palustrine	40%	59%	6%	8%	54%	33%
Riverine	45%	81%	7%	9%	47%	10%
<b>Total</b>	<b>43%</b>	<b>47%</b>	<b>7%</b>	<b>8%</b>	<b>49%</b>	<b>45%</b>

Although technically open to stock travel and grazing, much of the wetland and meadow area is inaccessible to stock parties and thus stock use would continue to be concentrated in named forage areas adjacent to maintained trails. Grazing, trampling, and non-native species impacts to wetland and meadow vegetation outside of named forage areas would continue to be rare and of light intensity; therefore, grazing and trampling impacts to wetland and meadow vegetation outside of named forage areas would be negligible.

Capacities, night and head limits, and other tools described in the Stock Use and Meadow Monitoring and Management Strategy described in appendix D would continue to be used to manage the intensity of grazing impacts.

The meadow capacities presented in appendix D reflect meadow size, moisture status, and productivity as well as site-specific vulnerabilities such as the potential for erosion and the presence of peat-accumulating soils or sensitive species. Utilization limits of 25–45% depending on vegetation zone, moisture level, and logistical value would be used to determine baseline grazing capacities which would be modified where monitoring data provides additional information. These capacities would be applied to all meadows open to grazing. Use of these capacities would reduce grazing and trampling impacts in the most popular destinations. They also would protect areas from increased grazing pressure that might result from displacement of grazing use from nearby meadows that have reached capacity or are otherwise restricted.

Administrative use of stock would likely remain at current levels and would occur in the same areas, although there may be localized and infrequent increase in use associated with the addition of some informal and abandoned trails to the maintained trail system. Commercial stock use could continue at current levels, but may decline or increase in response to socioeconomic drivers or in response to the closure of some trails and meadows to stock. Private use would likely continue at current levels or could continue to decline. Therefore, overnight stock use in the parks would be expected to remain similar to the 10-year average of 6,775 stock nights.

Grazing levels would likely continue to be similar to the 10-year average of 6,058 stock nights. If the increasing trend in the use of supplemental feed continued, there could be a slight overall reduction in grazing and thus in grazing and trampling impacts on meadows and wetlands. Grazing would likely continue to occur in approximately 41% of the meadow area open to grazing, although this could increase due to displacement of grazing use from meadows that have reached capacity or are otherwise restricted to forage areas which are currently unused.

The intensity of grazing in named forage areas (and therefore the extent and severity of impacts) would be limited by the capacities developed according to the methodology described in appendix D. Table 83 summarizes the number of forage areas and meadow vegetation within them which would be subject to grazing impacts.

**Table 83: Number of Forage Areas and Meadow Area Open to Grazing under Alternative 2 by Vegetation Zone and Logistical Value Used to Set Limits on Utilization**

Alternative 2 Vegetation Zone	Lower Logistical Value		Higher Logistical Value	
	Number of Forage Areas	Forage Area Acres	Number of Forage Areas	Forage Area Acres
Lower Montane & Woodland	46	225	14	86
Upper Montane & Subalpine	124	4378	41	714
<b>Total</b>	<b>170</b>	<b>4603</b>	<b>55</b>	<b>800</b>

In the 14 lower montane forage areas open to grazing with higher logistical value (totaling 86 acres), utilization would be limited to no more than 45% in moist meadows and 35% in dry or wet meadows. The amount of foliage left ungrazed at these levels would be approximately equal to the amount of herbage which would be expected to decompose annually; if grazed to capacity regularly, productivity would be

expected to remain near current levels which may or may not be similar to comparable ungrazed meadow vegetation.

In the remaining 46 lower montane forage areas open to grazing with lower logistical value (totaling 86 acres), utilization would be limited to no more than 35% in moist meadows and 25% in dry or wet meadows. The amount of foliage left ungrazed at these levels would be more than the amount of herbage which would be expected to decompose annually; if grazed to capacity regularly, productivity would be expected to trend towards or be similar to comparable ungrazed meadow vegetation.

In the 41 upper montane and subalpine forage areas open to grazing with higher logistical value (totaling 714 acres), utilization would be limited to no more than 35%. If grazed to capacity regularly, this level of utilization in dry *Carex filifolia* vegetation would, on average, reduce productivity by 10% and reduce basal vegetation cover by 16% relative to ungrazed vegetation. In moist to wet *Deschampsia cespitosa* vegetation, this level of utilization would, on average, reduce productivity by 18% relative to ungrazed vegetation. This level of utilization in moist *Calamagrostis muiriana* vegetation would, on average, reduce productivity by 16%, increase basal vegetation cover by 14%, and decrease relative graminoid cover by 12% relative to ungrazed vegetation.

In the remaining 124 upper montane and subalpine forage areas open to grazing with lower logistical value (totaling 4378 acres), utilization would be limited to no more than 25%. If grazed to capacity regularly, this level of utilization in dry *Carex filifolia* vegetation would, on average, increase productivity by 2% and increase basal vegetation cover by 7% relative to ungrazed vegetation. In moist to wet *Deschampsia cespitosa* vegetation, this level of utilization would, on average, decrease productivity by 11% relative to ungrazed vegetation. This level of utilization in moist *Calamagrostis muiriana* vegetation would, on average, reduce productivity by 10%, increase basal vegetation cover by 41%, and decrease relative graminoid cover by 6% relative to ungrazed vegetation.

Because horses and mules are selective grazers and overall grazing pressure is light, grazing impacts would generally be concentrated in one meadow vegetation type within a forage area. Grazing capacities would be based on the area of this preferred vegetation, which is usually less than the area of the entire meadow. Therefore, the extent of the most severe predicted impacts to meadow and wetland vegetation would be less than the total meadow area summarized above.

Trampling impacts on meadows would be directly related to grazing, since stock travelling through meadows open to access but closed to grazing would continue to be uncommon and infrequent. The timing of grazing would continue to be controlled by a system of opening dates tied to soil moisture and meadow conditions, which would reduce stock-related impacts in wetlands such as deep hoofprints, which are more likely to occur early in the season when soils are wet.

Potential nonnative species introductions would be proportional to the meadow area open to both access and grazing, as species deposited along trails and in camps may be propagule sources for wetlands and meadows. Restrictions on the kinds of feed that may be provided to stock would reduce propagule pressure on meadows to the extent that it replaces untreated feed. Surveys to provide for the early detection of nonnative species would be conducted as part of routine meadow monitoring and wilderness patrol activities.

Grazing levels and associated impacts would continue to be highest in popular meadows along the JMT corridor, in traditional destinations for visitors traveling with stock (such as Roaring River and Hockett Plateau), and in areas serving as foci for trail maintenance and construction crews. Implementation of grazing capacities for all user groups, and formalization of the management process described in appendix

D would reduce the incidence of overgrazing and establish thresholds for management action that would decrease potential for trampling and grazing impacts.

Several actions would mitigate stock impacts in these high use areas. Restricting grazing of Lower Whitney Creek and Upper Vidette meadows to private users only would help prevent overuse of these small but popular meadows. Additional meadow areas along the JMT and HST would also be closed to grazing entirely, which would limit impacts in popular areas. Under the proposed reduction in commercial stock based activities in the Mount Whitney Management Area, meadows in the Whitney and Rock Creek drainages would likely continue to be grazed to capacity, as available forage would be consumed before area-wide commercial use ceilings were reached. Coupled with the closure of Lower Crabtree Meadow, however, the total grazing capacity of the meadows in the area would be reduced and the use of supplemental feed products expected to increase.

Dusy Basin and Rae Lakes would no longer be open to overnight use by stock, which would lead to a decrease in potential trampling impacts from the holding and feeding of animals within 0.5 mile of the trail corridor. As under current use patterns this occurs infrequently, this action would serve to prevent potential impacts should use patterns or levels change.

The maximum number of stock in a party would be reduced to 12 head in the four cross-country stock travel areas and lower in a few locations, resulting in a slight decrease in the potential for trampling and grazing impacts in these areas. Under current use levels and patterns, stock use in these areas is rare; therefore, actual impacts in cross-country travel areas would not be expected to change significantly.

The existing corrals and supporting stock infrastructure in the Mineral King Valley could be relocated or modified to allow for short-term public camping or staging and/or short-term camping by commercial use authorization (CUA) holders. If these actions were taken, there could be short-term construction impacts to the adjacent wetlands, and increases in stock use in the destinations traditionally accessed from this area (Cliff Creek, Big Arroyo, Little Five Lakes, Big Five Lakes, Lost Canyon, Rattlesnake Canyon, Hockett Plateau) although impacts would be mitigated through the management process described in appendix D. Separate environmental compliance would be conducted.

Under alternative 2, overall trampling, grazing, and nonnative species impacts on meadows and wetlands would be expected to be reduced from current levels due to the implementation of meadow-specific grazing capacities and application of site-specific management actions. Any increase in levels of use or change in patterns of use would be expected to result in increased potential for trampling and/or grazing impacts; these would be mitigated using the management tools described in appendix D. The meadow capacities presented in appendix D reflect meadow size, moisture status, and productivity as well as site-specific vulnerabilities such as the potential for erosion and the presence of peat-accumulating soils or sensitive species. The use of these capacities would reduce grazing and trampling impacts in the most popular destinations. They also would protect areas from increased grazing pressure that might result from displacement of grazing use from nearby meadows that have reached capacity or are otherwise closed.

**High-elevation Long-lived Tree Species:** Greater restrictions on campfires would be put in place to protect old living trees and downed wood resources. Campfire restrictions would remain the same as under current conditions for the San Joaquin, Kings, Kaweah, Tule, and Soda Springs drainages. The campfire restrictions would be lowered 400 feet in the Kern drainage from their current 10,400 feet to 10,000 feet. This constraint would reduce impacts on vegetation in higher elevation areas where firewood is scarce and is not a sustainable resource. In these areas, downed trees would remain in place as a paleo resource and be available for water, nutrients, and potential habitat for seedlings, with trampling of existing vegetation reduced in the search for firewood. Below 10,000 feet, vegetation would continue to

be affected by trampling and firewood collection activities, although site-specific restrictions would be implemented where downed wood resources cannot sustain campfires, including: Hamilton Lakes, Mineral King Valley, Pinto Lake, and Redwood Canyon.

Campfires would be restricted in 442,096 acres of park wilderness while being permitted in 35,857 acres (10.3% of area) of high-elevation conifer habitat that supports the four subalpine or upper montane long-lived tree species (whitebark pine, foxtail pine, limber pine, and Sierra juniper). Considering just the three five-needle conifers, which would primarily be whitebark and foxtail pines, and to a lesser extent limber pine, this area would be 14,768 acres.

The greatest area of impacts from campfires and fuelwood gathering is within 328 feet of campfires and trails. Under alternative 2, these areas would represent approximately 1,322 acres of subalpine or upper montane long-lived tree species habitat that occurs in areas without campfire restrictions.

Proposed campfire restrictions would also protect the higher elevation habitat of non-target vegetation classes, which includes portions of the distribution of species such as lodgepole pine, mountain hemlock, western white pine, and red-fir forests. Under this alternative, this area would be approximately 44,480 acres.

**Alpine Vegetation:** Direct removal of alpine vegetation occurs infrequently, and is primarily associated with trail maintenance and construction activities. Under this alternative, impacts resulting from these activities would continue at existing levels, resulting in localized impacts on alpine plants.

Trampling of alpine vegetation along trail corridors and in high-elevation camp areas by human traffic would continue to occur. While these impacts can be locally severe, they are currently insignificant at the ecosystem scale, and this would be expected to remain the case.

Most trampling impacts would continue to occur along cross-country routes and in popular destinations where visitor use is concentrated. Areas where such impacts would be expected to continue to be seen would include Dusy Basin, the Mount Whitney area, Upper Darwin Canyon/Lamarck Col, Mount Langley, Kearsarge Lakes, and other similar high-elevation basins and routes popular with hikers. However, should other destinations increase in popularity (as periodically occurs in response to news articles, guidebooks, and information shared through social media) local trampling impacts in such areas would be expected to increase. With additional controls on visitor use in the Mount Whitney area, trampling impacts on alpine vegetation would be expected to stabilize along all routes leading into and through the area, especially through Miter Basin, Crabtree Pass, and along the JMT corridor. Increased popularity of Mount Langley, as an easily accessed 14,000+ foot peak, would continue to result in impacts on the sparsely vegetated summit area and along the multiple approach routes; however, these are expected to be mitigated soon by the establishment of a cairned route to the summit. Similarly, the increased popularity of alpine summits along the crest among ‘peak baggers’ would be expected to lead to increased development of informal trails and trampling of alpine vegetation, both on the summits and along approach routes.

Under proposed restrictions on stock access and grazing, 70% of the mapped alpine vegetation in the parks (including alpine meadows) would be closed to access by stock; 27% would remain open to stock access and grazing; and the remaining 3% open to access but closed to grazing. Stock trampling impacts on upland alpine vegetation would continue to be largely associated with established trails and routes, since cross-country stock travel through alpine areas is infrequent. Restricting stock use to pass-through and day use in Dusy Basin, lower Miter Basin, and Upper Blue Canyon, would prevent trampling impacts outside of the immediate trail corridor and those associated with holding and feeding animals. Although overnight use by stock in these areas is currently infrequent, these restrictions would ensure protection of the alpine vegetation in these areas should use patterns change. Closure of the Baxter Pass Trail to stock

would similarly prevent stock-related impacts on the alpine vegetation along the trail corridor. Trampling of alpine plants by hikers in the Baxter Pass area would continue, as the trail is often indistinguishable and travel over vegetation is unavoidable; under current use levels, such impacts would be localized to the primary route corridor. Should use of the area increase, impacts may become locally severe and require remediation.

In the alpine meadows, trampling impacts would continue to be associated with grazing, as cross-country travel in these areas is largely restricted and infrequent. The timing of grazing would continue to be controlled by a system of opening dates tied to meadow conditions to reduce stock-related impacts such as deep hoof prints, which are more likely to occur early in the season when soils are wet.

Grazing of upland alpine vegetation would continue to occur primarily in the drier meadow types such as the Wright Creek Meadow complex along the JMT, in the meadows of the headwaters of the Kern at Sheep Camp Meadows, in the meadows of upper Big Arroyo and Lost Canyon, and in Upper Basin. Grazing of wet alpine meadows would be expected to continue to occur sporadically in individual meadows along the JMT, including in the Twin Lakes and Palisade Lakes basins. The closure to grazing of the Lake South America loop, Upper LeConte Canyon, Woods Lake Basin, Bighorn Plateau, and Taboose Pass Meadows under this alternative would provide additional protection to these alpine meadows. Grazing of other alpine vegetation types, such as fell-fields, would be infrequent and associated with pass-through travel and in areas where stock can be held and fed but not grazed.

Administrative use of stock would likely remain at current levels and would occur in the same areas, although there may be localized and infrequent increases in use associated with the addition of some informal and abandoned trails to the maintained trail system. Free-roaming stock used to support trail maintenance activities would continue to graze alpine vegetation in Sheep Camp Meadows (north and east of the Tyndall Ranger Station) but not in the meadows of the Lake South America Loop. Under current use levels and patterns, grazing by commercial stock would be expected to continue to occur on a regular basis in the alpine uplands of the lower Wright Creek, in Sheep Camp Meadows, and occasionally in the lower Wallace Creek and Siberian Outpost area. Private grazing of alpine areas would be expected to remain infrequent and at very low intensities.

Grazing of alpine vegetation in the Evolution Lake basin would continue to be restricted to walking parties with burros or llamas. Because these animals have unshorn hooves, consume less forage than horses or mules, and are infrequently used as stock in the parks, trampling and grazing impacts on alpine vegetation would continue to be minimal in this area.

Under current use levels and patterns, vegetation in untrailed alpine areas would remain largely undisturbed. Any significant increase in levels of use or change in patterns of visitor use would be expected to result in increased trampling and/or grazing impacts on alpine vegetation.

**Plants of Conservation Concern (Park Sensitive Plant Species):** Direct removal of plants of conservation concern would continue to be expected to occur only under very limited circumstances, such as collections made in the course of research, inventory, or monitoring activities. Collection of voucher specimens is strictly regulated through the research permitting and environmental compliance processes to prevent population level impacts. Because the species of concern are by definition rare, the likelihood that they would be encountered by visitors and illegally collected is considered quite low.

Similarly, trampling of the plants of conservation concern by hikers would be expected to be infrequent under expected levels and patterns of use. Although species in the meadows and uplands may suffer incidental trampling by visitors traveling through meadows or on cross-country routes, this would not be expected to result in population-level impacts. The closure of the Baxter Pass Trail to stock travel, and of

the Woods Lake basin to grazing, would lead to increased protection of populations of *Astragalus ravenii* and *Streptanthus gracilis* in those areas. Thus, impacts on the seven vascular plant species of conservation concern known or suspected to occur in alpine upland areas frequented by cross-country hikers and used occasionally by stock, listed under alternative 1, would be expected to remain infrequent and insignificant at the population level.

If recreational rock climbing on the walls of the South Fork Kings River were to increase with the opening of the North Dome area to overnight camping, incidental impacts on individuals of marble rockmat (*Petrophyton caespitosum*), which grows in crevices and on ledges in the canyon, could be expected to increase. An increase in the use of existing routes and the development of additional new routes could lead to locally significant trampling impacts which could have measurable impacts on local populations. As the species is also found in remote, off-trail areas not favored by climbers, such impacts would not be expected to result in large-scale losses or declines that could lead to the listing of the species.

Impacts on the seven vascular plant species of conservation concern known or suspected to inhabit areas that are open to cross-country travel by stock, listed under alternative 1, would be expected to remain localized and insignificant at the population level. Exceptions to this are found along the floor of the lower Kern Canyon, where administrative grazing of the area known as the 'maze' coincides with the habitat of Kern River daisy, and on the Hockett Plateau where administrative stock tend to roam off trail and can potentially encounter populations of Tulare County bleeding heart, field ivesia, Hockett Meadows lupine, and purple mountain-parsley. Based on recent surveys, current use levels and patterns do not appear to be resulting in population level impacts on these species. As administrative stock use would not be expected to increase under this alternative, no large-scale losses or declines that could lead to the listing of these species would be expected.

The 18 vascular plant species of conservation concern either known to, or having the potential to, grow in or adjacent to meadows open to grazing by stock are listed under alternative 1. Impacts on these species would continue to be expected to be localized and would not be expected to result in large-scale losses or declines that could lead to the listing of any of the species.

The mosses of concern considered in this analysis (*Bruchia bolanderi*, *Helodium blandowii*, *Meesia triquetra*, *Meesia uliginosa*, and *Pohlia tundrae*) all grow in meadow environments. Specific actions proposed under this alternative that would lead to greater protection of these species from trampling and grazing impacts include the closure of the Lower Big Arroyo and Guyot Creek east of the JMT, which would protect the peat-accumulating wetlands there and the associated moss flora from impacts. The implementation of grazing capacities for all park meadows would also afford greater protection to the moss communities found in peat-accumulating wetlands as the capacities are based on the size of the area suitable for grazing; at relatively low levels of use, stock tend to avoid the wettest areas which support bryophytes.

Expanding the portion of the Miter Basin area open only to pass through and day rides by stock, coupled with the adoption of smaller party sizes for off-trail hikers and riders, would potentially provide additional protection to the habitat of tundra thread moss.

**Nonnative Plant Species:** Alternative 2 and all action alternatives would include measures to protect native vegetation and soils listed at the end of chapter 2 and further detailed in appendix N. Significantly, these mitigations would require that feed carried into wilderness would be processed pellets, rolled grains, or fermented hay. Baled or loose hay (which has no processing) and compressed hay cubes (which have minimal processing) would not be allowed in wilderness. California or Nevada certified weed free forage



(baled or loose hay, hay cubes, or straw bedding) would be required when hay products are used as supplemental forage or bedding in frontcountry zones.

California certified weed-free forage is field-inspected for nonnative plants on the California and federal noxious weed lists. However, it can still contain species considered desirable for hay production but considered invasive plants in wildlands; such as timothy, oats, barley, velvet grass, orchard grass, and reed canarygrass. In addition, many other plant species listed by the California Invasive Plant Council as invasive nonnative plants that threaten wildlands are not included on the California and federal noxious weed lists. Commercially processed pellets, rolled grains, and fermented hay have a high level of mechanical milling, heat treatment, and/or anaerobic fermentation that reduce live seed content. More risk can be tolerated in frontcountry sites, where the probability of detection is higher and there are fewer barriers to effective treatment of established plants than in wilderness sites, where probability of detection is low and there are more barriers to effective treatment of established plants.

These mitigations would reduce, but not eliminate, propagule introductions associated with stock use. Horses can carry live seed in their guts for several days; St. John-Sweeting and Morris (1991) found that peak seed transmission occurred three to four days after consumption, with some species being transmitted up to 10 days later. Purging of animals on certified weed-free feed, pellets, rolled grains, or fermented hay in advance of wilderness travel would be recommended but not required because it is difficult to enforce. In practice, purging would be implemented for administrative and concessions stock who are held in frontcountry corrals and pack stations and fed certified weed-free hay prior to wilderness travel. However, seeds of common pasture grasses could still be present in the certified weed-free hay and transported in guts of animals to wilderness.

Alternative 2 allows slightly less off-trail stock travel and off-trail meadow grazing than alternative 1, which would slightly lower the potential for introducing nonnative plants in areas where early detection would be difficult and costly. Total stock use would likely remain similar to current levels, but could be reduced slightly in popular use areas such as Rock Creek and Whitney Creek. Disturbance related to visitor use (trailhead quotas and group size) and facility maintenance (trail construction and maintenance, ranger station maintenance) would be similar to current conditions. Due to the implementation of stock-feed regulations and improved prevention mitigations, overall propagule pressure from stock, visitors, and administrative operations would be lower than it is currently. However, there could be an additional pack station at Wolverton and more developed frontcountry stock facilities at west side trailheads, creating more sources for invasive plant transport to wilderness. The overall probability of introductions would be slightly less than current conditions. Probability of introductions to high-value habitats (wetlands) would be slightly lower, since the percentage of meadow area open to grazing would decrease from 51% to 46%. Spatial distribution of impacts would be wide, and difficulty of detection would be similar to current conditions. Nonnative species impacts would be about the same overall.

**Cumulative Effects:** This alternative calls for similar numbers of visitors and stock wilderness-wide, reduces development, but allows for continued grazing. This alternative would reduce the percentage of meadow area that is open to stock travel from 64% to 54% and reduce the percentage of park meadows open to grazing from 51% to 46%. With the decrease in access, the potential for invasive species spread in meadows would be reduced. Alternative 2 would increase campfire restrictions, which would result in beneficial effects on subalpine trees.

Other than those ongoing projects and activities associated with the administration of wilderness (i.e., facility and visitor-use management), there are few past, present, or future foreseeable projects in the parks' wilderness that have a detectable effect on vegetation. The projects that may affect vegetation that are separate from projects proposed by this WSP/DEIS include the high-elevation forest monitoring program, the wetlands monitoring program, the Halstead and Cahoon meadow restorations, the ecological

restoration program, invasive species management plan and activities, and permitted research activities. The majority of other past, present, and future foreseeable projects in wilderness have no potential for effects on vegetation. The impacts from these seven projects, and of the Fire and Fuels Management Program, are described for alternative 1.

This alternative would result in impacts that are not substantially different from the no-action alternative (alternative 1) with similar visitor use levels and stock restrictions. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

### **IMPACTS OF ALTERNATIVE 3: PROVIDE MORE OPPORTUNITIES FOR PRIMITIVE RECREATION**

**Wetlands and Meadows:** Trampling of wetland and meadow vegetation by human traffic would continue to occur along wet trails that pass through meadows, along riparian corridors and lakeshores where campers pass through for water or to fish, and where visitors set up camps on or adjacent to meadow or riparian vegetation. While these impacts can be locally severe, they are currently insignificant at the ecosystem scale and this would be expected to remain the case. As current visitor-use levels could increase under this alternative, the extent and severity of human trampling of meadow and wetland vegetation would be expected to rise. However, additional infrastructure and increased controls on visitor behavior such as night limits or designated campsites in popular camp areas could offset the increase in visitation. Impacts could increase in severity locally, but it would be unlikely that these impacts would increase enough to be significant at the landscape scale. The development of informal trails would continue to pose potential risks to adjacent wetlands, which would be mitigated through visitor education, trail reroutes, or restoration.

Trampling and grazing of wetland and meadow vegetation by administrative and recreational pack and saddle stock would continue. Stock access and grazing would be managed according to the Stock Use and Meadow Monitoring and Management Strategy described in appendix D.

The trail network would be expanded as some informal and abandoned trails are added to the maintained trail system and become more developed to accommodate increased visitation. Stock travel would be allowed on most maintained trails. The number of trails where stock parties would be limited to day use would increase slightly. In areas open only to day use by stock parties, travel would be limited to within 100 yards of maintained trails. Stock parties would be prohibited from traveling on routes that are not maintained, except in four areas of the park where cross-country travel with stock would continue to be allowed. Off-trail travel by stock would no longer be allowed in the lower Big Arroyo, providing additional protection from trampling and grazing impacts on the wet meadows and peat-accumulating wetlands there.

Taken together, these actions would reduce the percentage of meadow area which is open to some form of stock travel and thus subject to trampling impacts from 64% to 55%.

The following additional locations, which are otherwise open to overnight stock use, would be closed to grazing: Crabtree Lakes (closed to stock access and grazing above existing camp west of lowest lake), Darwin Meadow proper, Forester Lake Meadow, Guyot Creek Meadows (expanding the existing closure to the meadows east of the trail), Kern Hot Spring Meadow, Kettle Dome meadows, Guitar Lake, Mineral King basin, Summit Lake Meadow, Upper LeConte Canyon above 10,000-foot elevation, and Milestone Creek.

Meadows in the areas newly closed to stock travel or only open to day use by stock parties under this alternative would also be closed to grazing. With the exception of the four areas open to cross-country travel by stock, grazing would continue to be allowed in most areas open to overnight stock use, although six meadows (Bighorn Plateau and the meadows south of Bighorn Plateau and west of the JMT and north of Wright Creek; Chagoopa Plateau #3 Meadow; Darwin Meadow; Grouse Meadow; Lower Crabtree Meadow; and Taboose Pass Meadow) would be closed to grazing for visitor experience and specific resource protection needs. In addition, most of the meadows in the four cross-country travel areas would be closed to grazing.

Overall, the percentage of park meadow area open to grazing would be reduced from 51% to 37% which would reduce the percentage of peat-accumulating meadow area from 70% to 49% and reduce the percentage of lakeshore meadow open to grazing from 42% to 27%.

Under this alternative, up to 46% of lacustrine features, 68% of palustrine features, 90% of riverine features, and up to 56% of all wetland features would be in areas open to stock travel. Within the area open to stock travel, up to 43% of lacustrine features, 46% of palustrine features, 81% of riverine features, and up to 36% of all wetland features would be in areas open to grazing.

Up to 46% of lacustrine features, 68% of palustrine features, 90% of riverine features, and up to 56% of all wetland features are in areas open to stock travel. Within the area open to stock travel, up to 43% of lacustrine features, 46% of palustrine features, 81% of riverine features, and up to 36% of all wetland features are in areas open to grazing.

**Table 84: Alternative 3 – Values are Percentages of Row (Meadow Type) Totals**

Meadow Type	Open to Stock Access; Open to Grazing	Open to Stock Access; Closed to Grazing	Closed to Stock Access
Fen	66%	18%	16%
Fen/wet meadow	55%	30%	15%
Wet meadow	42%	19%	39%
Moist meadow	28%	17%	56%
Dry meadow	38%	11%	50%
All meadow types	37%	18%	45%
Peat-accumulating area	49%	38%	13%
Lakeshore meadow	27%	18%	56%

**Table 85: Alternative 3 – Values are Percentages of Row (System) Totals for Each Kind of Wetland Feature (Linear or Area)**

System	Open to Stock Access; Open to Grazing		Open to Stock Access; Closed to Grazing		Closed to Stock Access	
	Linear	Area	Linear	Area	Linear	Area
Lacustrine	43%	17%	3%	17%	54%	66%
Palustrine	29%	46%	19%	22%	52%	32%
Riverine	38%	81%	16%	9%	46%	10%
<b>Total</b>	<b>35%</b>	<b>36%</b>	<b>17%</b>	<b>20%</b>	<b>48%</b>	<b>44%</b>

Although technically open to stock travel and grazing, much of the wetland and meadow area is inaccessible to stock parties, and thus stock use would continue to be concentrated in named forage areas

adjacent to maintained trails. Grazing of wetland and meadow vegetation outside of named forage areas would continue to be rare and of light intensity; therefore grazing and trampling impacts to wetland and meadow vegetation outside of named forage areas would be negligible.

Capacities, night and head limits, and other tools described in the Stock Use and Meadow Monitoring and Management Strategy described in appendix D would continue to be used to manage the intensity of grazing impacts.

The meadow capacities presented in appendix D reflect meadow size, moisture status, and productivity as well as site-specific vulnerabilities such as the potential for erosion and the presence of peat-accumulating soils or sensitive species. Utilization limits of 25–45% depending on vegetation zone, moisture level, and logistical value would be used to determine baseline grazing capacities which would be modified where monitoring data provides additional information. These capacities would be applied to all meadows open to grazing. The use of these capacities would reduce grazing and trampling impacts in the most popular destinations. They also would protect areas from increased grazing pressure that might result from displacement of grazing use from nearby meadows that have reached capacity or are otherwise restricted.

Administrative use of stock would likely remain at current levels or increase slightly since trail development would be greater than current conditions. Commercial stock use would likely increase to meet demand from additional visitation in popular areas and could also increase locally if the Mineral King and Wolverton pack stations were re-opened, although this could be offset somewhat by the new closures or restrictions on stock travel and grazing. Depending if the current trend in private stock use continues, private stock use could continue at current levels or decrease. Overall stock use would be expected to increase relative to the 10-year average of 6,775 stock nights.

Grazing levels would be expected to increase over the 10-year average of 6,058 stock nights, although this could be partially offset if the increasing trend in the use of supplemental feed continued. Grazing would likely occur in more than 55% of the area open to grazing; as increased use levels, reduced acreage open to grazing, and the establishment of capacities would likely combine to shift use to areas which have not been grazed in the last five years.

The intensity of grazing in named forage areas (and therefore the extent and severity of impacts) would be limited by the capacities developed according to the methodology described in appendix D. Table 86 summarizes the number of forage areas and meadow vegetation within them which would be subject to grazing impacts.

**Table 86: Number of Forage Areas and Meadow Area Open to Grazing under Alternative 3 by Vegetation Zone and Logistical Value Used to Set Limits on Utilization**

Alternative 3 Vegetation Zone	Lower Logistical Value		Higher Logistical Value	
	Number of Forage Areas	Forage Area Acres	Number of Forage Areas	Forage Area Acres
Lower Montane & Woodland	40	199	14	86
Upper Montane & Subalpine	109	4524	41	714
<b>Total</b>	<b>149</b>	<b>4722</b>	<b>55</b>	<b>800</b>

In the 14 lower montane forage areas with higher logistical value (totaling 86 acres), utilization would be limited to no more than 45% in moist meadows, and 35% in dry or wet meadows. The amount of foliage

left ungrazed at these levels would be approximately equal to the amount of herbage which would be expected to decompose annually; if grazed to capacity regularly, productivity would be expected to remain near current levels which may or may not be similar to comparable ungrazed meadow vegetation.

In the remaining 49 lower montane forage areas with lower logistical value and open to grazing (totaling 199 acres), utilization would be limited to no more than 35% in moist meadows and 25% in dry or wet meadows. The amount of foliage left ungrazed at these levels would be more than the amount of herbage which would be expected to decompose annually; if grazed to capacity regularly, productivity would be expected to trend towards or be similar to comparable ungrazed meadow vegetation.

In the 41 upper montane and subalpine forage areas with higher logistical value (totaling 714 acres), utilization would be limited to no more than 35%. If grazed to capacity regularly, this level of utilization in dry *Carex filifolia* vegetation would, on average, reduce productivity by 10% and reduce basal vegetation cover by 16% relative to ungrazed vegetation. In moist to wet *Deschampsia cespitosa* vegetation, this level of utilization would, on average, reduce productivity by 18% relative to ungrazed vegetation. This level of utilization in moist *Calamagrostis muiriana* vegetation would, on average, reduce productivity by 16%, increase basal vegetation cover by 14%, and decrease relative graminoid cover by 12% relative to ungrazed vegetation.

In the remaining 109 upper montane and subalpine forage areas (totaling 4,722 acres) with lower logistical value and open to grazing, utilization would be limited to no more than 25%. If grazed to capacity regularly, this level of utilization in dry *Carex filifolia* vegetation would, on average, increase productivity by 2% and increase basal vegetation cover by 7% relative to ungrazed vegetation. In moist to wet *Deschampsia cespitosa* vegetation, this level of utilization would, on average, decrease productivity by 11% relative to ungrazed vegetation. This level of utilization in moist *Calamagrostis muiriana* vegetation would, on average, reduce productivity by 10%, increase basal vegetation cover by 41%, and decrease relative graminoid cover by 6% relative to ungrazed vegetation.

Because horses and mules are selective grazers and overall grazing pressure is light, grazing impacts would generally be concentrated in one meadow vegetation type within a forage area. Grazing capacities would be based on the area of this preferred vegetation, which is usually less than the area of the entire meadow. Therefore, the extent of the most severe predicted impacts to meadow and wetland vegetation would be less than the total meadow area summarized above.

The maximum number of stock in a party would be increased to 25 head throughout most of the parks, resulting in an increase in the potential for trampling and grazing impacts where stock is allowed. Additional head limits in some locations would mitigate some of these impacts in popular or sensitive destinations.

Trampling impacts on meadows would continue to be directly related to grazing, since stock travel through meadows open to access but closed to grazing would be expected to continue to be relatively uncommon and infrequent. Trampling impacts would likely decrease in extent but have the potential for increased local impacts. The timing of grazing would continue to be controlled by a system of opening dates tied to meadow conditions to reduce stock-related impacts in wetlands such as deep hoofprints, which are more likely to occur early in the season when soils are wet.

Potential nonnative species introductions would be proportional to the meadow area open to both access and grazing, as species deposited along trails and in camps may be propagule sources for wetlands and meadows. Potential nonnative species impacts on meadows would decrease with the closure of more of the park meadows to stock access, although greater stock use could increase propagule pressure. Restrictions on the kinds of feed that may be provided to stock would reduce propagule pressure on

meadows to the extent that it replaces untreated feed. Surveys to provide for the early detection of nonnative species would be conducted as part of routine meadow monitoring and wilderness patrol activities.

Prohibitions on campfires could decrease stock use in some meadows above 9,000 feet by making these destinations less desirable to stock users.

Grazing pressure would continue to be highest in popular meadows along the JMT corridor, in traditional destinations for visitors traveling with stock (such as Roaring River and Hockett Plateau), and in areas serving as foci for trail maintenance and construction crews. Additional grazing restrictions (head and night limits) and the Stock Use and Meadow Monitoring and Management Strategy described in appendix D would continue to be used to manage the extent and severity of grazing impacts.

Under the proposed reduction in commercial stock based activities in the Mount Whitney Management Area, meadows would likely continue to be grazed to capacity, as available forage would be consumed before area-wide commercial use ceilings were reached. Coupled with the closure of Lower Crabtree Meadow, however, the total grazing capacity of the meadows in the area would be reduced and the use of supplemental feed products expected to increase.

The existing corrals and supporting stock infrastructure in the Mineral King Valley could be relocated or modified to allow for short-term public camping or staging by a contracted concessions service. If these actions were taken, there could be short-term construction impacts to the adjacent wetlands, and increases in stock use in the destinations traditionally accessed from this area (Cliff Creek, Big Arroyo, Little Five Lakes, Big Five Lakes, Lost Canyon, Rattlesnake Canyon, Hockett Plateau) although impacts would be mitigated through the management process described in appendix D. Separate environmental compliance would be conducted.

The overall impact of grazing to meadows would depend on how stock use patterns change in response to the changes in access and grazing regulations. Fewer meadows would be open to grazing, including some meadows that are popular stock destinations, resulting in less meadow area subject to grazing impacts. There would be little change in actual grazing impacts in the off-trail travel areas which are closed to grazing, as current use levels are extremely low. However, if stock use remains the same or increases in popular areas and stock users graze alternative sites to those closed to grazing under this alternative, grazing intensity could increase (up to established capacities) on the meadows which remain open to grazing. The increase in localized grazing impacts could be moderated by the increased controls on visitor behavior, if stock users carry feed to replace the grazing areas which have been closed, or if stock users shift use to areas that currently receive little stock use.

Under alternative 3, it is most likely that there would be a net increase in grazing and trampling impacts on meadows and wetlands, as higher use would be concentrated in fewer destinations. These impacts would be mitigated using the management tools described in appendix D.

**High-elevation Long-lived Tree Species:** Effects of trampling on forest habitat of high-elevation long-lived tree species under alternative 3 would be similar to those experienced under current conditions, with several improvements. Portions of the Rae Lakes and San Joaquin watersheds would discontinue stock access, thus reducing trampling impacts in fairly dense whitebark pine habitat. Conversely, an increase in visitor use and party sizes could increase the amount of traffic, and thus trampling, through subalpine habitat.

Wilderness-wide, campfires would be restricted to less than 9,000 feet, making alternative 3 more protective from impacts of firewood collection than alternatives 1 and 2. Alternative 3 would reduce the

amount of wilderness area that would allow campfires in the San Joaquin, Kings, and Kern drainages. There would also be site-specific restrictions for areas below this elevation. This would result in 293,840 acres (or approximately 35%) of wilderness in the parks where campfires would be permitted. Overall, alternative 3 includes the second greatest acreage of high-elevation areas with campfire restrictions in area where foxtail pine, whitebark pine, limber pine, and Sierra juniper occur. Under alternative 3, recreational campfires would be restricted in 543,965 total acres of the parks. In wilderness areas of the parks, campfires would be permitted in 13,126 acres of high-elevation conifer habitat that supports the four subalpine long-lived tree species (whitebark pine, foxtail pine, limber pine, and Sierra juniper). Considering just the three five-needle conifers, which would primarily be whitebark and foxtail pines and to a lesser extent limber pine, this area would be 667 acres.

The greatest area of impacts from campfires and fuelwood gathering is within 328 feet of campfires and trails. Under alternative 3, these areas would represent approximately 607 acres of subalpine or upper montane long-lived tree species habitat that occurs in areas without campfire restrictions.

The proposed campfire restrictions would also protect the higher elevation habitat of non-target vegetation classes, which includes portions of the distribution of species such as lodgepole pine and mountain hemlock. In the Kaweah River drainage, with restriction starting at 9,000 feet, this would include some western white pine and red fir forest as well. Under this alternative this area would be approximately 90,516 acres.

**Alpine Vegetation:** Direct removal of alpine vegetation occurs infrequently, and is primarily associated with trail maintenance and construction activities. Under this alternative, impacts resulting from these activities would continue at existing levels, resulting in localized impacts on alpine plants.

Trampling of alpine vegetation along trail corridors and in high-elevation camp areas by human traffic would continue to occur. While these impacts can be locally severe, they are currently insignificant at the ecosystem scale and this would be expected to remain the case. The increased visitor use expected under this alternative would likely expand the campsite area subject to such impacts and lead to an increase in impacts in popular areas.

Depending on where they were located, the installation of new food-storage boxes in five alpine areas in Kings Canyon National Park—Dusy Basin, Evolution Lake, Marjorie Lake, Palisades Lake, and Twin Lakes—could result in severe impacts on alpine vegetation in the immediate vicinity of the boxes, with less severe but notable impacts radiating outward along routes used to access the boxes. Increased camping associated with these newly established boxes would also likely result in the removal and trampling of alpine vegetation.

Most trampling impacts would continue to occur along cross-country routes and in popular destinations where visitor use is concentrated. Areas where such impacts would be expected to continue to be seen would include Dusy Basin, the Mount Whitney area, Upper Darwin Canyon/Lamarck Col, Mount Langley, Kearsarge Lakes, and other similar high-elevation basins and routes popular with hikers. However, should other destinations increase in popularity (as periodically occurs in response to news articles, guidebooks, and information shared through social media) local trampling impacts in such areas would be expected to increase. With additional controls on visitor use in the Mount Whitney area, trampling impacts on alpine vegetation would be expected to stabilize along all routes leading into and through the area, especially through Miter Basin, Crabtree Pass, and along the JMT corridor. Increased popularity of Mount Langley, as an easily accessed 14,000+ foot peak, would continue to result in impacts on the sparsely vegetated summit area and along the multiple approach routes; however, these are expected to be mitigated soon by the establishment of a cairned route to the summit. Similarly, the increased popularity of alpine summits

along the crest among ‘peak baggers’ would be expected to lead to increased development of informal trails and trampling of alpine vegetation, both on the summits and along approach routes.

Under proposed restrictions on stock access and grazing, 69% of the mapped alpine vegetation in the parks (including alpine meadows) would remain closed to access by stock; 15% would remain open to stock access and grazing, with the remaining 16% open to access but closed to grazing. Unless cross-country stock travel through alpine areas increased in popularity, trampling impacts on upland alpine vegetation would continue to be largely associated with established trails and routes. Restricting stock use to pass through and day use in Dusy Basin, lower Miter Basin, and Upper Blue Canyon, would prevent trampling impacts outside of the immediate trail corridor and those associated with holding and feeding animals. Although overnight use by stock in these areas is currently infrequent, these restrictions would ensure protection of the alpine vegetation in these areas should the expected increase in use under this alternative be realized.

Closure of the Baxter Pass Trail to stock would similarly prevent stock-related impacts on the alpine vegetation along the trail corridor. Trampling of alpine plants by hikers in the Baxter Pass area would continue, as the trail is often indistinguishable and travel over vegetation is unavoidable; under increased use levels, such impacts would be expected to expand beyond the primary route corridor. Such impacts may become locally severe and require remediation.

In the alpine meadows, trampling impacts would continue to be associated with grazing. With closure of most meadows to grazing within the cross-country areas, impacts on the alpine meadows in these areas would be prevented. The timing of grazing would continue to be controlled by a system of opening dates tied to meadow conditions to reduce stock-related impacts such as deep hoof prints, which are more likely to occur early in the season when soils are wet.

Grazing of upland alpine vegetation would continue to occur primarily in the drier meadow types, such as the Wright Creek Meadow complex along the JMT, in the meadows of the headwaters of the Kern at Lake South America and Sheep Camp Meadows, in the meadows of upper Big Arroyo and Lost Canyon, and in Upper Basin. Grazing of wet alpine meadows would be expected to continue to occur more frequently in individual meadows along the JMT, including in the Twin Lakes and Palisade Lakes basins. Grazing of other alpine vegetation types, such as fell-fields, would likely continue to be infrequent, associated with pass-through travel, and in areas where stock can be held and fed but not grazed.

Administrative use of stock would likely remain at current levels or increase slightly since trail development would be greater than current conditions. Free-roaming stock used to support trail maintenance activities would continue to graze alpine vegetation in the meadows of the Lake South America Loop and in Sheep Camp Meadows (north and east of the Tyndall Ranger Station). Under increased use levels and patterns, grazing by commercial stock would be expected to increase in the alpine uplands of the lower Wright Creek, in Sheep Camp Meadows, and in the lower Wallace Creek and Siberian Outpost areas. Private grazing of alpine areas would be expected to remain infrequent and at very low intensities.

Grazing of alpine vegetation in the Evolution Lake basin would continue to be restricted to walking parties with burros or llamas. Because these animals have unshorn hooves, consume less forage than horses or mules, and are infrequently used as stock in the parks, trampling and grazing impacts on alpine vegetation would continue to be minimal in this area.

Under increased use levels and expanded use patterns, impacts on vegetation in untrailed alpine areas would be expected to increase both in extent and severity.



**Plants of Conservation Concern (Park Sensitive Plant Species):** Direct removal of plants of conservation concern would continue to be expected to occur only under very limited circumstances, such as collections made in the course of research, inventory, or monitoring activities. Collection of voucher specimens is strictly regulated through research permitting and environmental compliance processes to prevent population level impacts. Because the species of concern are by definition rare, the likelihood that they would be encountered by visitors and illegally collected would remain quite low.

The potential for trampling of the plants of conservation concern by hikers could rise with the increased levels and patterns of use anticipated under this alternative. Species in the meadows and uplands may be subject to incidental trampling by visitors traveling through meadows or on cross-country routes, although this would not be expected to result in population level impacts, the likelihood of local impacts would increase commensurate with increasing use levels. The closure of the Baxter Pass Trail to stock would lead to increased protection of populations of *Astragalus ravenii* and *Streptanthus gracilis* in that area. Thus impacts on the seven vascular plant species of conservation concern known or suspected to occur in alpine upland areas frequented by cross-country hikers and used occasionally by stock, listed under alternative 1, would be expected to increase in frequency yet remain insignificant at the population level with proper monitoring and mitigation efforts.

Depending on their location, the installation of new food-storage boxes may increase the likelihood of trampling of special status plant populations in the nearby area. Site selection would be subject to survey and evaluation to prevent impacts on any special status plant populations in the vicinity.

If recreational rock climbing on the walls of the South Fork Kings River were to increase with the opening of the North Dome area to overnight camping, incidental impacts on individuals of marble rockmat, which grows in crevices and on ledges in the canyon, could be expected to increase. An increase in the use of existing routes and the development of additional new routes could lead to locally significant trampling impacts which could have measurable impacts on local populations. As the species is also found in remote, off-trail areas not favored by climbers, such impacts would not be expected to result in large scale losses or declines that could lead to the listing of the species.

Impacts on the seven vascular plant species of conservation concern known or suspected to inhabit areas that are open to cross-country travel by stock, listed under alternative 1, would be expected to remain localized and insignificant at the population level. Exceptions to this are found along the floor of the lower Kern Canyon (where administrative grazing of the area known as the 'maze' coincides with the habitat of Kern River daisy), and on the Hockett Plateau (where administrative stock tend to roam off trail and can potentially encounter populations of Tulare County bleeding heart, field ivesia, Hockett Meadows lupine, and purple mountain-parsley). Based on recent surveys, current use levels and patterns do not appear to be resulting in population level impacts on these species. Under this alternative, as administrative grazing in these areas would decrease relative to current levels, protection of these species from large-scale losses or declines that could lead to the listing of these species would be increased.

The eighteen vascular plant species of conservation concern either known to or having the potential to grow in or adjacent to meadows open to grazing by stock are listed under alternative 1. Because grazing intensity in meadows would be managed through the implementation of site-specific grazing capacities, impacts on these species would continue to be localized and would not be expected to result in large-scale losses or declines that could lead to the listing of any of the species. The potential for such localized impacts would be expected to increase in frequency and extent with any significant increase in use, as the holding and feeding of animals in camps adjacent to meadows also has the potential to impact special-status plants.

The mosses of concern considered in this analysis (*Bruchia bolanderi*, *Helodium blandowii*, *Meesia triquetra*, *Meesia uliginosa*, and *Pohlia tundrae*) all grow in meadow environments. Specific actions proposed under this alternative that would lead to greater protection of these species from trampling and grazing impacts include the closure to grazing of Guyot Creek east of the JMT, which would protect the peat-accumulating wetlands there and the associated moss flora from impacts. The implementation of grazing capacities for all park meadows would also afford greater protection to the moss communities found in peat-accumulating wetlands as the capacities are based on the size of the area suitable for grazing; at relatively low levels of use, stock tend to avoid the wettest areas which support bryophytes.

Expanding the portion of the Miter Basin area open only to pass through and day rides by stock would potentially provide additional protection to the habitat of tundra thread moss.

**Nonnative Plant Species:** Alternative 3 allows slightly less off-trail stock travel and off-trail stock grazing than alternative 1, which would slightly lower the potential for introducing nonnative plants in areas where early detection would be difficult and costly. Total stock use would likely increase relative to current levels. Disturbance related to increased visitor use (higher trailhead quotas and stock group size) and facility maintenance (more trail construction and maintenance) would be slightly higher than current conditions. Overall propagule pressure would be similar to current conditions due to the implementation of stock-feed regulations and improved prevention mitigations, but increased propagule pressure from more visitors, new or improved trails, and higher levels of administrative operations (more trail crew camps). There could be additional pack stations at Wolverton and Mineral King, and more developed frontcountry stock facilities at west-side trailheads, creating more sources for invasive plant transport to wilderness. The overall probability of introductions would be about the same as current conditions. Probability of introductions to high-value habitats (wetlands) would be lower, since the percentage of meadow area open to grazing would decrease from 51% to 37%. Spatial distribution of impacts would be wide, and difficulty of detection would be high. Nonnative species impacts would be expected to increase overall, primarily in those areas where visitor use increases significantly.

**Cumulative Effects:** Alternative 3 would result in an increase in the number of visitors and stock wilderness-wide, would increase development slightly, and would allow for continued grazing; though most off-trail areas would be closed to grazing. This alternative would reduce the percentage of meadow area that is open to stock travel from 64% to 55% and reduce the percentage of park meadows open to grazing from 51% to 37%. With the decrease in access, the potential for invasive species spread in meadows would be reduced. Alternative 3 would increase campfire restrictions, which would result in beneficial effects on subalpine trees when compared to current conditions.

The projects that may affect vegetation that are separate from projects proposed by this WSP/DEIS include the high-elevation forest monitoring program, the wetlands monitoring program, the Halstead and Cahoon meadow restorations, the ecological restoration program, invasive species management plan and activities, and permitted research activities. The majority of other past, present, and future foreseeable projects in wilderness have no potential for effects on vegetation. The impacts from these seven projects are described for alternative 1. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

## **IMPACTS OF ALTERNATIVE 4: EMPHASIZE UNDEVELOPED QUALITY AND NON-COMMERCIAL RECREATION**

**Wetlands and Meadows:** Trampling of wetland and meadow vegetation by human traffic would continue to occur along wet trails that pass through meadows, along riparian corridors and lakeshores where campers pass through for water or to fish, and where visitors set up camps on or adjacent to

meadow or riparian vegetation. While these impacts can be locally severe, they are currently insignificant at the landscape scale and this would be expected to remain the case. As visitor-use levels would decrease under this alternative, the extent and severity of human trampling of meadow and wetland vegetation would be expected to decrease accordingly. The development of such informal trails would continue to pose potential risks to adjacent wetlands, which would be mitigated through visitor education, trail reroutes, or restoration.

Grazing of wetland and meadow vegetation by administrative and recreational pack and saddle stock would be prohibited. Trampling of wetland and meadow vegetation by administrative and recreational pack and saddle stock would occur where visitors travel with stock through these habitats. Stock use would be managed according to the Stock Use and Meadow Monitoring and Management Strategy described in appendix D with a focus on managing impacts from confining and feeding stock in camp areas.

Trails would be reduced in number and the network of trails less developed. Stock travel would be allowed on many maintained trails for private and administrative stock users. Many maintained trails would be closed or limited to day use only for commercial users. The number of trails where stock parties would be limited to day use would increase slightly. In areas open only to day use by stock parties, travel would be limited to within 100 yards of maintained trails. Stock parties would be prohibited from traveling on routes which are not maintained, except in four areas of the park where cross-country travel with stock would continue to be allowed for private parties only. Taken together, these actions would reduce the percentage of meadow area which is open to some form of stock travel and thus subject to trampling impacts from 64% to 43%.

All grazing of stock would be prohibited, reducing the percentage of meadow area open to grazing from 51% to 0%. This would reduce the percentage of peat-accumulating meadow area open to grazing from 70% to 0% and reduce the percentage of lakeshore meadow open to grazing from 42% to 0%.

Under this alternative, up to 46% of lacustrine features, 57% of palustrine features, 88% of riverine features, and up to 47% of all wetland features are in areas open to stock travel.

**Table 87: Alternative 4 – Values are Percentages of Row (Meadow Type) Totals**

Meadow Type	Open to Stock Access; Open to Grazing	Open to Stock Access; Closed to Grazing	Closed to Stock Access
Fen	0%	74%	26%
Fen/wet meadow	0%	70%	30%
Wet meadow	0%	48%	52%
Moist meadow	0%	35%	65%
Dry meadow	0%	36%	64%
All meadow types	0%	43%	57%
Peat-accumulating area	0%	77%	23%
Lakeshore meadow	0%	37%	63%

**Table 88: Alternative 4 – Values are Percentages of Row (System) Totals for Each Kind of Wetland Feature (Linear or Area)**

System	Open to Stock Access; Open to Grazing		Open to Stock Access; Closed to Grazing		Closed to Stock Access	
	Linear	Area	Linear	Area	Linear	Area
Lacustrine	0%	0%	46%	28%	54%	72%
Palustrine	0%	0%	39%	57%	61%	43%
Riverine	0%	0%	46%	88%	54%	12%
<b>Total</b>	<b>0%</b>	<b>0%</b>	<b>43%</b>	<b>47%</b>	<b>57%</b>	<b>53%</b>

Although technically open to stock travel, much of the wetland and meadow area is inaccessible to stock parties and thus stock use would continue to be concentrated in areas adjacent to maintained trails. Furthermore, there would be few destinations open to stock travel which would require that stock users travel through meadows and wetlands, thus trampling and non-native species impacts associated with stock use would continue to be concentrated in areas adjacent to maintained trails.

Administrative use of stock would likely be greatly reduced since trail length and development would be much less than current conditions. Commercial stock use would likely be reduced in proportion to the amount of trails and areas closed to commercial stock travel, as well as the increased cost of carrying feed. The current downward trend in private stock use would likely continue or accelerate as private stock users would be less likely to overcome the extra logistics and expense of carrying feed. Total stock use would likely decrease greatly relative to the 10 year average of 6,775 stock nights.

Grazing levels would decrease to 0 from the 10-year average of 6,058 stock nights. Some grazing might occur if animals become untethered, but such incidental grazing would be expected to occur infrequently and associated impacts would be negligible.

There would be nearly complete elimination of trampling impacts on meadow vegetation since stock travel through meadows open to access but closed to grazing would continue to be uncommon and infrequent.

Potential nonnative species impacts would decrease overall with the closure of much of the park meadows to stock access, although there could be an increase in impacts in the areas of the park that remain open to stock travel if replacement feed sources increase propagule pressure.

The maximum number of stock per party would be reduced to 15 head on trail and seven head off trail, with a few specific exceptions. This would result in a decrease in the potential for trampling impacts where stock is allowed. This could be partially offset by the removal or relaxation of some camping limits, allowing for greater lengths of stay.

Potential nonnative species introductions are proportional to the meadow area open to access, as species deposited along trails and in camps may be propagule sources for meadows. Increased localized disturbance at sites used to hold and feed stock could become loci for potential nonnative plant introductions; either through the inadvertent use of untreated feed products or from manure. If such plants were allowed to become established, propagules from these areas could then be transported into nearby wetlands or meadows.

A complete ban on campfires, grazing, and the removal of all food-storage boxes, would remove these as factors influencing stock travel. Travel by commercial users would be restricted to fewer locations. The prohibition on grazing would likely decrease stock travel to remote locations requiring long trips where the requirement to carry feed is impractical.

The existing corrals and supporting stock infrastructure in the Mineral King Valley could be relocated or modified to allow for short-term public camping or staging by private or administrative stock users. If these actions were to be considered, short-term impacts would be expected to the adjacent wetlands and separate environmental compliance would be conducted.

Under alternative 4, overall grazing and trampling impacts on meadows and wetlands would be almost entirely eliminated. Nonnative species impacts on meadows and wetlands would be expected to decrease overall, although there could be a chance for increased impacts in some areas if non-treated feed products were inadvertently used, or due to the increased propagule pressure likely to occur with an increase in volume of carried feed products. The monitoring system described in appendix D would be employed to track use, document conditions, and provide information for preventing and mitigating impacts associated with stock use but not related to grazing. Stock use would continue to be adaptively managed and informed by the results of the stock-use monitoring program, with increased emphasis on the prevention and mitigation of impacts associated with holding and feeding animals.

**High-elevation Long-lived Tree Species:** Alternative 4 would be the most protective of the alternatives for high-elevation long-lived conifers, as no campfires would be allowed in wilderness. It includes the greatest acreage with campfire restrictions on high-elevation areas that support foxtail pine, whitebark pine, limber pine, and Sierra juniper. Under alternative 4, recreational campfires would be restricted in 837,806 total acres of the parks or 100% of wilderness. It would include all areas of high-elevation conifer habitat where the four long-lived tree species occur within the parks. Beside the target vegetation classes where campfires would be restricted, the elevational designations specified in the five alternatives will also result in the inclusion of some non-target vegetation classes that fall within the elevational limits. This would include a wide range of vegetation types distributed throughout wilderness from low to high elevations.

**Alpine Vegetation:** Direct removal of alpine vegetation occurs infrequently, and is primarily associated with trail maintenance and construction activities. Under this alternative, impacts resulting from these activities would be somewhat diminished, as the trail class of some trails would be downgraded. Such impacts on alpine plants would remain localized.

Trampling of alpine vegetation along trail corridors and in high-elevation camp areas by human traffic would continue to occur. While these impacts can be locally severe, they are currently insignificant at the ecosystem scale and this would be expected to remain the case.

Most trampling impacts would continue to occur along cross-country routes and in popular destinations where visitor use is concentrated, although at lower use levels these may be somewhat reduced. Areas where such impacts would be expected to continue to be seen, and potentially increase, would include Dusy Basin, the Mount Whitney area, Upper Darwin Canyon/Lamarck Col, Mount Langley, Kearsarge Lakes, and other similar high-elevation basins and routes popular with hikers. However, should other destinations increase in popularity (as periodically occurs in response to news articles, guidebooks, and information shared through social media) local trampling impacts in such areas would be expected to increase. With additional controls on visitor use in the Mount Whitney area, trampling impacts on alpine vegetation would be expected to stabilize along all routes leading into and through the area, especially through Miter Basin, Crabtree Pass, and along the JMT corridor. Increased popularity of Mount Langley, as an easily accessed 14,000+ feet peak, would continue to result in impacts on the sparsely vegetated

summit area and along the multiple approach routes; however, these are expected to be mitigated by the establishment of a cairned route to the summit in 2014. Similarly, the increased popularity of alpine summits along the crest among ‘peak baggers’ would be expected to lead to increased development of informal trails and trampling of alpine vegetation, both on the summits and along approach routes.

Under proposed restrictions on stock access, 76% of the mapped alpine vegetation in the parks (including alpine meadows) would remain closed to access by stock, and the remaining 24% would remain open to access. No grazing would be allowed under this alternative. Trampling impacts on upland alpine vegetation would continue to be largely associated with established trails and routes, since cross-country stock travel through alpine areas would be expected to remain infrequent. Restricting stock use to pass through and day use in lower Miter Basin would prevent trampling impacts outside of the immediate trail corridor and those associated with holding and feeding animals. Restricting travel by commercial stock along the trails to Funston Lake, Granite Lake, and over New Army Pass would result in decreased stock use in these areas, but as use by commercial stock in these areas is currently infrequent, these restrictions would have limited effect on alpine vegetation.

Closure of the Baxter Pass, Colby Pass, Elizabeth Pass, Upper Goddard Canyon, Hell-for-Sure, Sawmill and Shepherd Pass trails as well as the Mineral, Mosquito, Eagle, White Chief, and Monarch Lake basins to all stock would similarly prevent stock-related impacts on the alpine vegetation along those trail corridors. Trampling of alpine plants by hikers in the Baxter Pass area would continue, as the trail is often indistinguishable and travel over vegetation is unavoidable; under lower use levels, such impacts would continue to be localized to the primary route corridor. Should use of the area increase, impacts may become locally severe and require remediation.

The closure of the four off-trail areas to commercial and administrative stock would not be expected to result in changes in observed impacts, as use of these areas is currently infrequent and uncommon.

Trampling of alpine meadows currently open to grazing would largely cease, although low levels of trespass grazing and trampling would be expected. The removal of all drift fences and gates would mean that animals who became untethered would likely roam farther afield than under current conditions, with a possible increase in off-trail trampling impacts as a result. These would be expected to be infrequent.

The number of areas used for the holding and feeding of stock would by necessity increase with the prohibition on grazing. Should stock supported parties elect to camp in alpine areas, this could result in increased local, severe impacts on alpine vegetation. The inherent difficulty of holding animals in treeless areas, however, would be expected to limit such use in the alpine areas.

Free-roaming stock used to support trail maintenance activities would no longer graze alpine vegetation in Sheep Camp Meadows (north and east of the Tyndall Ranger Station), the Lake South America Loop, or any other alpine location. Similarly, grazing of the Siberian Outpost area would cease and impacts on the alpine vegetation there would be reduced. Private use of alpine areas would be expected to remain infrequent and at very low intensities.

Under reduced use levels and patterns and a parks wide prohibition on grazing, vegetation in untrailed alpine areas would remain largely undisturbed.

**Plants of Conservation Concern (Park Sensitive Plant Species):** Direct removal of plants of conservation concern would continue to be expected to occur only under very limited circumstances, such as collections made in the course of research, inventory, or monitoring activities. Collection of voucher specimens is strictly regulated through the research permitting and environmental compliance processes

to prevent population level impacts. Because the species of concern are by definition rare, the likelihood that they would be encountered by visitors and illegally collected would remain quite low.

Similarly, trampling of the plants of conservation concern by hikers would be expected to be infrequent under reduced levels and patterns of use. Although species in the meadows and uplands may suffer incidental trampling by visitors traveling through meadows or on cross-country routes, this would not be expected to result in population level impacts. The closure of the Baxter Pass Trail and the Woods Lake basin to stock travel, would lead to increased protection of populations of *Astragalus ravenii* and *Streptanthus gracilis* in those areas. Thus impacts on the seven vascular plant species of conservation concern known or suspected to occur in alpine upland areas frequented by cross-country hikers and used occasionally by stock, listed under alternative 1, would be expected to remain infrequent and insignificant at the population level.

The removal of all food-storage boxes in wilderness could have an indirect effect on plants of conservation concern if use currently concentrated near the boxes became more dispersed and shifted into areas currently not being used for camping. Such impacts would be expected to be localized and insignificant at the population level.

If recreational rock climbing on the walls of the South Fork Kings River were to increase with the opening of the North Dome area to overnight camping, incidental impacts on individuals of marble rockmat, which grows in crevices and on ledges in the canyon, could be expected to increase. An increase in the use of existing routes and the development of additional new routes could lead to locally significant trampling impacts which could have measurable impacts on local populations. As the species is also found in remote, off-trail areas not favored by climbers, such impacts would not be expected to result in large-scale losses or declines that could lead to the listing of the species.

Impacts on the seven vascular plant species of conservation concern known or suspected to inhabit areas that are open to cross-country travel by stock, listed under alternative 1, would be expected to decrease with the reduction in overall use and additional restrictions on cross-country travel by commercial and administrative stock proposed under this alternative. These impacts would thus remain localized and insignificant at the population level. The potential for impact on the habitat of Kern River daisy, and on the Hockett Plateau, where administrative stock currently tend to roam off trail and can potentially encounter populations of Tulare County bleeding heart, field ivesia, Hockett Meadows lupine, and purple mountain-parsley, would be significantly reduced by the elimination of grazing and the restriction of off-trail use.

The eighteen vascular plant species of conservation concern either known to or having the potential to grow in or adjacent to meadows currently open to grazing by stock are listed under alternative 1. Potential impacts on those species restricted to meadows would be significantly reduced with the elimination of grazing under this alternative. An increase in holding and feeding of stock adjacent to meadows, however, could lead to increased impacts on those species growing near camp areas, especially if hold-and-feed areas were expanded. With proper monitoring and mitigation, such impacts would continue to be expected to be localized and would not be expected to result in large-scale losses or declines that could lead to the listing of any of the species.

*Mosses* – The mosses of concern considered in this analysis (*Bruchia bolanderi*, *Helodium blandowii*, *Meesia triquetra*, *Meesia uliginosa*, and *Pohlia tundrae*) all grow in meadow environments. The elimination of grazing under this alternative would significantly increase protection of meadow habitat by preventing trampling impacts on wetland mosses.

Expanding the portion of the Miter Basin area open only to pass through and day rides by stock, coupled with the adoption of smaller party sizes for off-trail hikers and riders, would potentially provide additional protection to the habitat of tundra thread moss.

Overall, the elimination of grazing and reduction in overall visitor-use levels would be expected to lead to a decrease in potential impacts on the plants of conservation concern.

**Nonnative Plant Species:** Alternative 4 would allow off-trail stock travel for private users only and would eliminate grazing in meadows, substantially lowering the potential for introducing nonnative plants in areas where early detection would be difficult and costly. Total stock use would likely greatly decrease relative to current levels. Localized disturbance in hold-feed areas would likely be severe, but overall disturbance related to visitor use (lower trailhead quotas and group size) and facility maintenance (less trail construction and maintenance, less ranger station maintenance) would be much lower than current conditions. Due to the implementation of stock-feed regulations and improved prevention mitigations, plus substantially decreased propagule pressure from fewer visitors, fewer trails, and much lower levels of administrative operations (zero long-term established trail crew camps and 9 fewer ranger stations and patrol cabins), overall propagule pressure would be substantially lower than current conditions. This lowering would be slightly offset by the increased risk of introducing nonnative propagules through substantial increases in carried feed. Although frontcountry facilities supporting stock use could be developed for private use, services at the Cedar Grove pack station would be reduced, and no commercial pack stations would be permitted at Wolverton or Mineral King, reducing the frontcountry sources for invasive plant transport to wilderness. Probability of introductions to high-value habitats (wetlands) would be much lower, since no meadows would be grazed, including the administrative pastures in the Kern Canyon, Redwood Meadow, and Roaring River, which have had frequent nonnative plant introductions in the past. Because off-trail stock travel would be prohibited for all but private stock users and meadows would not be grazed, the spatial distribution of impacts and difficulty of detection would be much lower. Alternative 4 would result in substantial beneficial effects on native plant communities from reduced disturbance and reduced nonnative plant propagule pressure.

**Cumulative Effects:** Alternative 4 calls for a decrease in the number of stock, restricts commercial access (and levels of services) and eliminates grazing wilderness-wide. These changes could result in a reduction of impacts on vegetation wilderness-wide. This alternative would reduce the percentage of meadow area that is open to stock travel from 64% to 43% and reduce the percentage of park meadows open to grazing from 51% to 0%. With the decrease in access, the potential for invasive species spread in meadows would be reduced. Alternative 4 would eliminate campfires in wilderness, which would result in beneficial effects on subalpine trees when compared to current conditions.

The projects that may affect vegetation that are separate from projects proposed by this WSP/DEIS include the high-elevation forest monitoring program, the wetlands monitoring program, the Halstead and Cahoon meadow restorations, the ecological restoration program, invasive species management plan and activities, and permitted research activities. The majority of other past, present, and future foreseeable projects in wilderness have no potential for effects on vegetation. The impacts from these seven projects, and of the Fire and Fuels Management Program, are described for alternative 1. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under alternative 4 that would constitute a significant cumulative effect.

## **IMPACTS OF ALTERNATIVE 5: EMPHASIZE OPPORTUNITIES FOR SOLITUDE**

**Wetlands and Meadows:** Trampling of wetland and meadow vegetation by human traffic would continue to occur along wet trails that pass through meadows, along riparian corridors and lakeshores where campers pass through for water or to fish, and where visitors set up camps on or adjacent to



meadow or riparian vegetation. While these impacts can be locally severe, they are currently insignificant at the landscape scale, and this would be expected to remain the case. As current visitor-use levels could decrease under this alternative, the extent and severity of human trampling of meadow and wetland vegetation would be expected to decrease. The development of informal trails would continue to pose potential risks to adjacent wetlands, which would be mitigated through visitor education, trail reroutes, or restoration.

Trampling and grazing of wetland and meadow vegetation by administrative and recreational pack and saddle stock would continue. Stock access and grazing would be managed according to the Stock Use and Meadow Monitoring and Management Strategy described in appendix D.

The trail network would be similar in length to current conditions, but less developed. Stock travel would continue to be allowed on most maintained trails. The number of trails where stock parties would be limited to day use would increase slightly. In areas open only to day use by stock parties, travel would be limited to within 100 yards of maintained trails. Stock parties would be prohibited from traveling on routes which are not maintained, and the four areas of the park where cross-country travel with stock is currently allowed would be closed to stock travel.

These actions would reduce the percentage of meadow area which is open to some form of stock travel and thus subject to trampling impacts from 64% to 43%.

Meadows in the areas newly closed to stock travel, or only open to day use by stock parties under this alternative would also be closed to grazing. Grazing would continue to be allowed in most areas open to overnight stock use, although a handful of meadows would be closed to grazing for specific resource protection needs.

Overall, the percentage of park meadow area open to grazing would be reduced from 51% to 36% which would reduce the percentage of the peat-accumulating meadow area open to grazing from 70% to 47% and reduce the percentage of lakeshore meadow open to grazing from 42% to 25%. Up to 43% of lacustrine features, 51% of palustrine features, 90% of riverine features, and up to 42% of all wetland features are in areas open to stock travel. Within the area open to stock travel, up to 43% of lacustrine features, 45% of palustrine features, 82% of riverine features, and up to 35% of all wetland features are in areas open to grazing.

**Table 89: Alternative 5 – Values are Percentages of Row (Meadow Type) Totals**

<b>Meadow Type</b>	<b>Open to Stock Access; Open to Grazing</b>	<b>Open to Stock Access; Closed to Grazing</b>	<b>Closed to Stock Access</b>
Fen	66%	9%	25%
Fen/wet meadow	56%	12%	33%
Wet meadow	40%	6%	53%
Moist meadow	27%	5%	68%
Dry meadow	37%	7%	57%
All meadow types	36%	6%	57%
Peat-accumulating area	47%	11%	42%
Lakeshore meadow	25%	6%	68%

**Table 90: Alternative 5 – Values are Percentages of Row (System) Totals for Each Kind of Wetland Feature (Linear or Area)**

System	Open to Stock Access; Open to Grazing		Open to Stock Access; Closed to Grazing		Closed to Stock Access	
	Linear	Area	Linear	Area	Linear	Area
Lacustrine	43%	16%	0%	6%	57%	77%
Palustrine	29%	45%	5%	6%	66%	49%
Riverine	38%	82%	6%	8%	56%	10%
<b>Total</b>	<b>34%</b>	<b>35%</b>	<b>6%</b>	<b>6%</b>	<b>60%</b>	<b>58%</b>

Although technically open to stock travel and grazing, much of the wetland and meadow area is inaccessible to stock parties, and thus stock use would continue to be concentrated in named forage areas adjacent to maintained trails. Grazing of wetland and meadow vegetation outside of named forage areas would continue to be rare and of light intensity; therefore grazing and trampling impacts to wetland and meadow vegetation outside of named forage areas would be negligible.

Capacities, night and head limits, and other tools described in the Stock Use and Meadow Monitoring and Management Strategy described in appendix D would continue to be used to manage the intensity of grazing impacts.

The meadow capacities presented in appendix D reflect meadow size, moisture status, and productivity, as well as site-specific vulnerabilities such as the potential for erosion and the presence of peat-accumulating soils or sensitive species. Utilization limits of 25–45% depending on vegetation zone, moisture level, and logistical value would be used to determine baseline grazing capacities which would be modified where monitoring data provides additional information. These capacities would be applied to all meadows open to grazing. The use of these capacities would reduce grazing and trampling impacts in the most popular destinations. They also would protect areas from increased grazing pressure that might result from displacement of grazing use from nearby meadows that have reached capacity or are otherwise restricted

Administrative use of stock would likely decrease since trail development would be lower than current conditions. Commercial stock use would be expected to decrease in proportion to quota reductions and the amount of trails and areas closed to stock travel and grazing. Depending whether the current trend in private stock use continues, private stock use could continue at current levels or decrease. Total stock use would thus decrease relative to the 10-year average of 6,775 stock nights.

Grazing levels would likely decrease relative to the 10 year average of 6,058 stock nights. If the increasing trend in the use of supplemental feed continued, there could be an additional slight reduction in grazing, and thus in grazing and trampling impacts on meadows and wetlands. Grazing would likely continue to occur in approximately 58% of the meadow area open to grazing.

The intensity of grazing in named forage areas (and therefore the extent and severity of impacts) would be limited by the capacities developed according to the methodology described in appendix D. Table 91 summarizes the number of forage areas and meadow vegetation within them which would be subject to grazing impacts.

**Table 91: Number of Forage Areas and Meadow Area Open to Grazing under Alternative 5 by Vegetation Zone and Logistical Value Used to Set Limits on Utilization**

Alternative 5 Vegetation Zone	Lower logistical value		Higher logistical value	
	Number of Forage Areas	Forage Area Acres	Number of Forage Areas	Forage Area Acres
Lower Montane & Woodland	40	200	14	86
Upper Montane & Subalpine	103	4467	41	714
<b>Total</b>	<b>143</b>	<b>4667</b>	<b>55</b>	<b>800</b>

In the 14 lower montane forage areas with higher logistical value (totaling 86 acres), utilization would be limited to no more than 45% in moist meadows, and 35% in dry or wet meadows. The amount of foliage left ungrazed at these levels would be approximately equal to the amount of herbage which would be expected to decompose annually; if grazed to capacity regularly, productivity would be expected to remain near current levels which may or may not be similar to comparable ungrazed meadow vegetation.

In the remaining 40 lower montane forage areas open to grazing with lower logistical value (totaling 200 acres), utilization would be limited to no more than 35% in moist meadows, and 25% in dry or wet meadows. The amount of foliage left ungrazed at these levels would be more than the amount of herbage which would be expected to decompose annually; if grazed to capacity regularly, productivity would be expected to trend towards or be similar to comparable ungrazed meadow vegetation.

In the 41 upper montane and subalpine forage areas open to grazing with higher logistical value (totaling 714 acres), utilization would be limited to no more than 35%. If grazed to capacity regularly, this level of utilization in dry *Carex filifolia* vegetation would, on average, reduce productivity by 10% and reduce basal vegetation cover by 16% relative to ungrazed vegetation. In moist to wet *Deschampsia cespitosa* vegetation, this level of utilization would, on average, reduce productivity by 18% relative to ungrazed vegetation. This level of utilization in moist *Calamagrostis muiriana* vegetation would, on average, reduce productivity by 16%, increase basal vegetation cover by 14%, and decrease relative graminoid cover by 12% relative to ungrazed vegetation.

In the remaining 103 upper montane and subalpine forage areas open to grazing with lower logistical value (totaling 4667 acres), utilization would be limited to no more than 25%. If grazed to capacity regularly, this level of utilization in dry *Carex filifolia* vegetation would, on average, increase productivity by 2% and increase basal vegetation cover by 7% relative to ungrazed vegetation. In moist to wet *Deschampsia cespitosa* vegetation, this level of utilization would, on average, decrease productivity by 11% relative to ungrazed vegetation. This level of utilization in moist *Calamagrostis muiriana* vegetation would, on average, reduce productivity by 10%, increase basal vegetation cover by 41%, and decrease relative graminoid cover by 6% relative to ungrazed vegetation.

Because horses and mules are selective grazers and overall grazing pressure is light, grazing impacts would generally be concentrated in one meadow vegetation type within a forage area. Grazing capacities would be based on the area of this preferred vegetation, which is usually less than the area of the entire meadow. Therefore, the extent of the most severe predicted impacts to meadow and wetland vegetation would be less than the total meadow area summarized above.

The maximum number of stock per party would be reduced to 13 head, resulting in a decrease in the potential for trampling and grazing impacts where stock is allowed. This could be partially offset by the removal or relaxation of some camping and grazing night limits, allowing for greater lengths of stay.

Trampling impacts on meadows would continue to be directly related to grazing, since stock travel through meadows open to access but closed to grazing would be expected to continue to be relatively uncommon and infrequent. Trampling impacts would likely decrease in extent but have the potential for local impacts to increase. The timing of grazing would continue to be controlled by a system of opening dates tied to meadow conditions to reduce stock-related impacts in wetlands such as deep hoofprints, which are more likely to occur early in the season when soils are wet.

Potential nonnative species introductions would be proportional to the meadow area open to both access and grazing, as species deposited along trails and in camps may be propagule sources for wetlands and meadows. Restrictions on the kinds of feed that may be provided to stock would reduce propagule pressure on meadows to the extent that it replaces untreated feed. Surveys to provide for the early detection of nonnative species would be conducted as part of routine meadow monitoring and wilderness patrol activities.

Grazing pressure would continue to be highest in popular meadows along the JMT corridor, in traditional destinations for visitors traveling with stock (such as Roaring River and Hockett Plateau), and in areas serving as foci for trail maintenance and construction crews. Decreases in trailhead quotas and implementation of the Stock Use and Meadow Monitoring and Management Strategy described in appendix D would continue to be used to manage the intensity of grazing impacts.

Prohibitions on campfires could decrease stock use in some meadows above 10,000 feet. The removal of all food-storage boxes would remove these as factors influencing stock travel.

Off-trail travel zones would be closed to stock access, although there would be little reduction in actual grazing impacts in the off-trail travel areas which are closed to grazing, as current use levels of these meadows are extremely low.

Under this alternative, the Redwood Meadow pasture fence would be removed and the Kern and Hockett Meadow pastures would be reduced in size. This would result in a slight decrease in the extent of trampling and grazing impacts in those areas, but could lead to increased severity of trampling impacts within the remaining fenced area.

All facilities at Mineral King administrative corrals and pack station in east Mineral King Valley would be removed, and the area would be restored to natural conditions. The ranger stations at Bearpaw, Bench Lake, Little Five Lakes, and Monarch would also be removed and the areas restored. These actions would have the potential to result in short-term impacts on the adjacent wetlands. Separate environmental compliance would be conducted.

Under alternative 5, fewer meadows would be open to grazing, resulting in less meadow area subject to grazing impacts. Overall grazing impacts on meadows would be expected to decrease with lower overall stock use and grazing levels. Trampling impacts on meadows would follow grazing impacts; they would be reduced overall. Potential nonnative species impacts would decrease with the closure of more of the park meadows to stock access.

**High-elevation Long-lived Tree Species:** Effects of trampling under alternative 5 would be reduced from current conditions. Portions of the Upper San Joaquin and Rae Lakes watershed would prohibit stock access completely, reducing the effects of trampling in these areas. In addition, stock would be

prohibited from accessing off-trail areas, eliminating trampling effects on forest habitat of high-elevation long-lived tree species from stock in these areas. In addition, trailhead quotas would be reduced by 10% wilderness-wide and party sizes would be lowered, resulting in a reduction in traffic.

Alternative 5 would limit campfires to below 10,000 feet wilderness-wide. Campfire limitations would remain the same as current limits in the San Joaquin and Kings River drainages, be more restrictive in Kern River drainage, and less restrictive in Kaweah and Tule River drainages than current conditions with the elevation for the restrictions rising by 1,000 feet. Although little whitebark pine and no limber pine habitat exists in Kaweah and Tule River drainages, raising the elevation limit would increase potential impacts from trampling and wood collection on foxtail pine and Sierra Juniper, which occur in the higher elevations of these drainages. The Kern River drainage would benefit from the implementation of alternative 5, as additional subalpine vegetation and whitebark pine habitat would be protected by lowering the elevation limit 400 feet. All areas of the parks would be subject to some impacts from trampling and firewood collection at elevations below 10,000 feet under alternative 5.

Under alternative 5, recreational campfires would be restricted in 412,530 total acres of the parks. In wilderness areas of the parks, campfires would be permitted in 37,144 acres (29%) of high-elevation conifer habitat that supports the four subalpine long-lived tree species (whitebark pine, foxtail pine, limber pine, and Sierra juniper). Considering just the three five-needle conifers, which would primarily be whitebark and foxtail pines and to a lesser extent limber pine, this area would be 16,786 acres.

Alternative 5 results in the second greatest acreage of high-elevation areas without campfire restrictions (425,276 acres). The greatest area of impacts from campfires and fuelwood gathering is within 328 feet of campfires and trails. Under alternative 5, these areas would represent approximately 1,426 acres of subalpine or upper montane long-lived tree species habitat that occurs in areas without campfire restrictions; again the second largest area.

The proposed campfire restrictions would also protect the higher-elevation habitat of non-target vegetation classes, which includes portions of the distribution of species such as lodgepole pine and mountain hemlock. In the Kaweah River drainage, with restrictions starting at 9,000 feet, this would include some western white pine and red-fir forest as well. Under this alternative this area would be approximately 28,422 acres.

**Alpine Vegetation:** Direct removal of alpine vegetation occurs infrequently, and is primarily associated with trail maintenance and construction activities. Under this alternative, impacts resulting from these activities would continue at slightly reduced levels, resulting in localized impacts on alpine plants.

Trampling of alpine vegetation along trail corridors and in high-elevation camp areas by human traffic would continue to occur. Such impacts would be expected to decrease under this alternative relative to current conditions. While these impacts can be locally severe, they are currently insignificant at the ecosystem scale and this would be expected to remain the case.

Most trampling impacts would continue to occur along cross-country routes and in popular destinations where visitor use is concentrated. Areas where such impacts would be expected to continue to be seen would include Dusy Basin, the Mount Whitney area, Upper Darwin Canyon/Lamark Col, Mount Langley, Kearsarge Lakes, and other similar high-elevation basins and routes popular with hikers. However, should other destinations increase in popularity (as periodically occurs in response to news articles, guidebooks, and information shared through social media) local trampling impacts in such areas would be expected to increase. With additional controls on visitor use in the Mount Whitney area, trampling impacts on alpine vegetation would be expected to stabilize along all routes leading into and through the area, especially through Miter Basin, Crabtree Pass, and along the JMT corridor. Increased popularity of Mount Langley,

as an easily accessed 14,000+ feet peak, would continue to result in impacts on the sparsely vegetated summit area and along the multiple approach routes; however, these are expected to be mitigated soon by the establishment of a cairned route to the summit. Similarly, the increased popularity of alpine summits along the crest among ‘peak baggers’ would be expected to lead to increased development of informal trails and trampling of alpine vegetation, both on the summits and along approach routes.

Under proposed restrictions on stock access and grazing, 83% of the mapped alpine vegetation in the parks (including alpine meadows) would remain closed to access by stock; 14% would remain open to stock access and grazing, with the remaining 3% open to access but closed to grazing. Trampling impacts on upland alpine vegetation would continue to be largely associated with established trails and routes, since cross-country stock travel through alpine areas is infrequent and this would likely continue to be the case. Restricting stock use to pass through and day use in Dusy Basin, lower Miter Basin, and Upper Blue Canyon would prevent trampling impacts outside of the immediate trail corridor and those associated with holding and feeding animals. Although overnight use by stock in these areas is currently infrequent, these restrictions would ensure protection of the alpine vegetation in these areas should use patterns change. Closure of the Baxter Pass Trail to stock would similarly prevent stock-related impacts on the alpine vegetation along the trail corridor. Trampling of alpine plants by hikers in the Baxter Pass area would continue, as the trail is often indistinguishable and travel over vegetation is unavoidable; under lower use levels, such impacts would remain localized to the primary route corridor.

In the alpine meadows, trampling impacts would continue to be associated with grazing, as cross-country travel in these areas is largely restricted and infrequent. The timing of grazing would continue to be controlled by a system of opening dates tied to meadow conditions to reduce stock-related impacts such as deep hoof prints, which are more likely to occur early in the season when soils are wet.

Grazing of upland alpine vegetation would continue to occur primarily in the drier meadow types such as the Wright Creek Meadow complex along the JMT, in the meadows of the headwaters of the Kern at Sheep Camp Meadows, in the meadows of upper Big Arroyo and Lost Canyon, and in Upper Basin. Grazing of wet alpine meadows would be expected to continue to occur sporadically in individual meadows along the JMT, including in the Twin Lakes and Palisade Lakes basins. The closure of the Upper LeConte Canyon and the Woods Lake Basin to grazing under this alternative would provide additional protection to these alpine meadows. Grazing of other alpine vegetation types, such as fell-fields, would be infrequent and associated with pass-through travel and in areas where stock can be held and fed but not grazed.

Administrative use of stock would likely decrease since trail development would be lower than current conditions. Free-roaming stock used to support trail maintenance activities would continue to graze alpine vegetation in the Lake South America Loop and in Sheep Camp Meadows (north and east of the Tyndall Ranger Station), but not in the meadows. Under lower use levels and patterns, grazing by commercial stock would be expected to continue to occur on a regular basis in the alpine uplands of the lower Wright Creek, in Sheep Camp Meadows, and occasionally in the lower Wallace Creek and Siberian Outpost area. Private grazing of alpine areas would be expected to remain infrequent and at very low intensities.

Grazing of alpine vegetation in the Evolution Lake basin would continue to be restricted to walking parties with burros or llamas. Because these animals have unshorn hooves, consume less forage than horses or mules, and are infrequently used as stock in the parks, trampling and grazing impacts on alpine vegetation would continue to be minimal in this area. The Mineral King basin would be closed to grazing, and overnight use of the Mosquito, Eagle, and White Chief basins would continue to be restricted to walking parties with burros or llamas, resulting in only minimal trampling impacts on associated alpine vegetation in those areas.

Under reduced use levels, vegetation in untrailed alpine areas would remain largely undisturbed.

**Plants of Conservation Concern (Park Sensitive Plant Species):** Direct removal of plants of conservation concern would continue to be expected to occur only under very limited circumstances, such as collections made in the course of research, inventory, or monitoring activities. Collection of voucher specimens is strictly regulated through the research permitting and environmental compliance processes to prevent population level impacts. Because the species of concern are by definition rare, the likelihood that they would be encountered by visitors and illegally collected would remain quite low.

Similarly, trampling of the plants of conservation concern by hikers would be expected to be infrequent under the reduced use levels proposed under this alternative. Although species in the meadows and uplands may suffer incidental trampling by visitors traveling through meadows or on cross-country routes, this would not be expected to result in population level impacts. The closure of the Baxter Pass Trail to stock would lead to increased protection of populations of *Astragalus ravenii* and *Streptanthus gracilis* in that area. Thus, impacts on the seven vascular plant species of conservation concern known or suspected to occur in alpine upland areas frequented by cross-country hikers and used occasionally by stock, listed under alternative 1, would be expected to remain infrequent and insignificant at the population level.

If recreational rock climbing on the walls of the South Fork Kings River were to increase with the opening of the North Dome area to overnight camping, incidental impacts on individuals of marble rockmat, which grows in crevices and on ledges in the canyon, could be expected to increase. An increase in the use of existing routes and the development of additional new routes could lead to locally significant trampling impacts which could have measurable impacts on local populations. As the species is also found in remote, off-trail areas not favored by climbers, such impacts would not be expected to result in large-scale losses or declines that could lead to the listing of the species.

Impacts on the seven vascular plant species of conservation concern known or suspected to inhabit areas that are open to cross-country travel by stock, listed under alternative 1, would be further protected with the elimination of cross-country travel by stock proposed under this alternative. Exceptions to this would continue to be found along the floor of the lower Kern Canyon (where administrative grazing of the area known as the 'maze' coincides with the habitat of Kern River daisy), and on the Hockett Plateau (where administrative stock tend to roam off trail and can potentially encounter populations of Tulare County bleeding heart, field ivesia, Hockett Meadows lupine, and purple mountain-parsley).

The proposed change in access to these areas would likely not result in a significant change in these use patterns, as the areas frequented by stock largely fall within 0.5 mile of the trail corridor and within designated forage areas. Based on recent surveys, current use levels and patterns do not appear to be resulting in population level impacts on these species. As administrative stock use and grazing would be expected to decrease under this alternative, the potential for impacts to these species would decrease and no large-scale losses or declines that could lead to their listing would be expected.

The 18 vascular plant species of conservation concern either known, or having the potential, to grow in or adjacent to meadows open to grazing by stock are listed under alternative 1. With an overall decrease in use, impacts on these species would continue to be expected to be localized and would not be expected to result in large-scale losses or declines that could lead to the listing of any of the species.

The mosses of concern considered in this analysis (*Bruchia bolanderi*, *Helodium blandowii*, *Meesia triquetra*, *Meesia uliginosa*, and *Pohlia tundrae*) all grow in meadow environments. Specific actions proposed under this alternative that would lead to greater protection of these species from trampling and grazing impacts include the closure of the four off-trail areas and Guyot Creek east of the JMT, which

would protect the peat-accumulating wetlands and their associated moss flora from impacts. The implementation of grazing capacities for park meadows would also afford greater protection to the moss communities found in peat-accumulating wetlands as the capacities are based on the size of the area suitable for grazing; at relatively low levels of use, stock tend to avoid the wettest areas which support bryophytes.

Expanding the portion of the Miter Basin area open only to pass through and day rides by stock, coupled with the adoption of smaller party sizes for off-trail hikers and riders, would potentially provide additional protection to the habitat of tundra thread moss.

Overall, the restriction of off-trail travel by stock, and reduction in overall use levels proposed under this alternative would be expected to lead to a decrease in potential impacts on the plants of conservation concern.

**Nonnative Plant Species:** Alternative 5 would not allow off-trail stock travel and would reduce off-trail grazing in meadows, substantially lowering the potential for introducing nonnative plants in areas where early detection would be difficult and costly. Total stock use would decrease relative to current levels. Overall disturbance related to visitor use (lower trailhead quotas and group size) and facility maintenance (trail construction and maintenance, ranger station maintenance) would be lower than current conditions. Due to the implementation of stock-feed regulations and improved prevention mitigations, plus decreased propagule pressure from fewer visitors and lower levels of administrative operations (zero long-term established trail crew camps and four fewer ranger stations and patrol cabins), overall propagule pressure would be substantially lower than current conditions. No pack station would be permitted at Mineral King and no commercial pack station at Wolverton, reducing the frontcountry sources for invasive plant transport to wilderness. Probability of introductions to high-value habitats (wetlands) would be lower, since 15% less meadow area could be grazed than current conditions. The spatial distribution of impacts and difficulty of detection would be much lower, since off-trail stock travel would be prohibited and grazed meadow area would be reduced. Alternative 5 would result in substantial beneficial effects on native plant communities from reduced disturbance and reduced nonnative plant propagule pressure.

**Cumulative Effects:** Alternative 5 calls for a decrease in the number of visitors and stock wilderness-wide, reduces development, but allows for continued grazing. Fewer visitors would result in a reduction of adverse impacts wilderness-wide; however, the net benefit would be minimal. This alternative would reduce the percentage of meadow area that is open to stock travel from 64% to 43% and reduce the percentage of park meadows open to grazing from 51% to 36%. With the decrease in access, the potential for invasive species spread in meadows would be reduced. Alternative 5 would alter campfire restrictions from current conditions, which would result in beneficial effects on subalpine trees in the Kern River drainage when compared to current conditions, and negative effects on subalpine trees in the Kaweah and Tule drainages.

The projects that may affect vegetation that are separate from projects proposed by this WSP/DEIS include the high-elevation forest monitoring program, the wetlands monitoring program, the Halstead and Cahoon meadow restorations, the ecological restoration program, invasive species management plan and activities, and permitted research activities. The majority of other past, present, and future foreseeable projects in wilderness have no potential for effects on vegetation. The impacts from these seven projects, and of the Fire and Fuels Management Program, are described for alternative 1. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under alternative 5 that would constitute a significant cumulative effect.



## CONCLUSION

**Wetlands and Meadows:** Under all alternatives, continuation of current wilderness management policies, including protection of cultural resources, natural processes, visitor education, and restrictions on amounts and locations of overnight use, would continue to protect wetlands and meadows in the wilderness of Sequoia and Kings Canyon National Parks.

Trampling of wetland and meadow vegetation by human traffic would continue to occur along trails that pass through meadows, along riparian corridors and lakeshores where campers pass through to collect water or to fish, and where visitors set up camps on or adjacent to meadow or riparian vegetation. While these impacts can be locally severe, they are currently insignificant at the landscape scale and this would be expected to remain the case.

Under all alternatives, wetland and meadow vegetation would be affected by visitor activities. The use of administrative and recreational stock would continue to be the source of most impacts on these communities. Alternatives 1, 2, 3, and 5 would allow some level of grazing in 35–51% of the wetlands and 36–51% of the meadows in the parks' wilderness. All alternatives would prohibit stock access in a portion of the parks' wetlands and meadows, ranging from 36–58% of the wetland features and 36–57% of the meadows. Although technically open to stock travel and grazing, much of the wetland and meadow area is inaccessible to stock parties, and thus stock use would continue to be concentrated in named forage areas adjacent to maintained trails. Grazing of wetland and meadow vegetation outside of named forage areas would continue to be rare and of light intensity; therefore grazing and trampling impacts to wetland and meadow vegetation outside of named forage areas would be negligible. Under existing use levels and patterns, less than half of the area open to stock use would continue to be grazed by stock; any increase in use or shift in those patterns would have the potential to cause an increase in the number of areas subject to grazing.

Under alternative 1, meadows in popular areas and of high strategic value for those travelling with stock would continue to be grazed at higher intensities and could show impacts such as increases in bare ground and reductions in productivity. These meadows would be subject to regular monitoring and assessment, and impacts would be addressed using the management tools described in the 1986 SUMMP and BMP. Under alternatives 2, 3 and 5, grazing would be managed according to the Stock Use and Meadow Monitoring and Management Strategy described in appendix D, which would include the application of site-specific grazing capacities to all meadows open to grazing. The use of these capacities would reduce grazing and trampling impacts in the most popular destinations. It would also provide protection to those areas which otherwise may be subject to increased grazing pressure in response to the implementation of temporary restrictions nearby or other changes in use patterns. Under anticipated use levels and patterns, impacts would continue to be most detectable in popular meadows along the JMT, in those areas serving as foci for trail crews and mounted rangers, and in the Roaring River and Hockett areas.

Under each of the alternatives where grazing would continue, any shifts in use to currently ungrazed meadows would have the potential to result in local increases in bare ground, decreases in production, and changes in vegetation composition associated with the introduction of grazing to areas currently not being used by stock. These changes would not be expected to contribute to changes considered ecologically significant at the landscape scale. These potential impacts would be mitigated through the continued monitoring and management of stock use and grazing.

Although alternative 3 would decrease the acreage of wetland and meadow vegetation open to grazing, increased use levels could lead to an increase in severity of localized impacts associated with stock use in those areas that would remain open. The proposed increase in party size from 20 to 25 animals under this alternative would also have the potential to increase trampling impacts in wetlands associated with trails

and camps. Under each of the action alternatives, implementation of new restrictions on commercial outfitters may result in the displacement of stock use to other areas of the park, which could cause new impacts in meadows that are currently infrequently used. These potential impacts would be mitigated through the implementation of the Stock Use and Meadow Monitoring and Management Strategy described in appendix D.

The elimination of all grazing as proposed under alternative 4 would have a beneficial effect on wetland areas that are currently open to grazing. Alternative 4 would thus have the most beneficial effect on wetland and meadow vegetation.

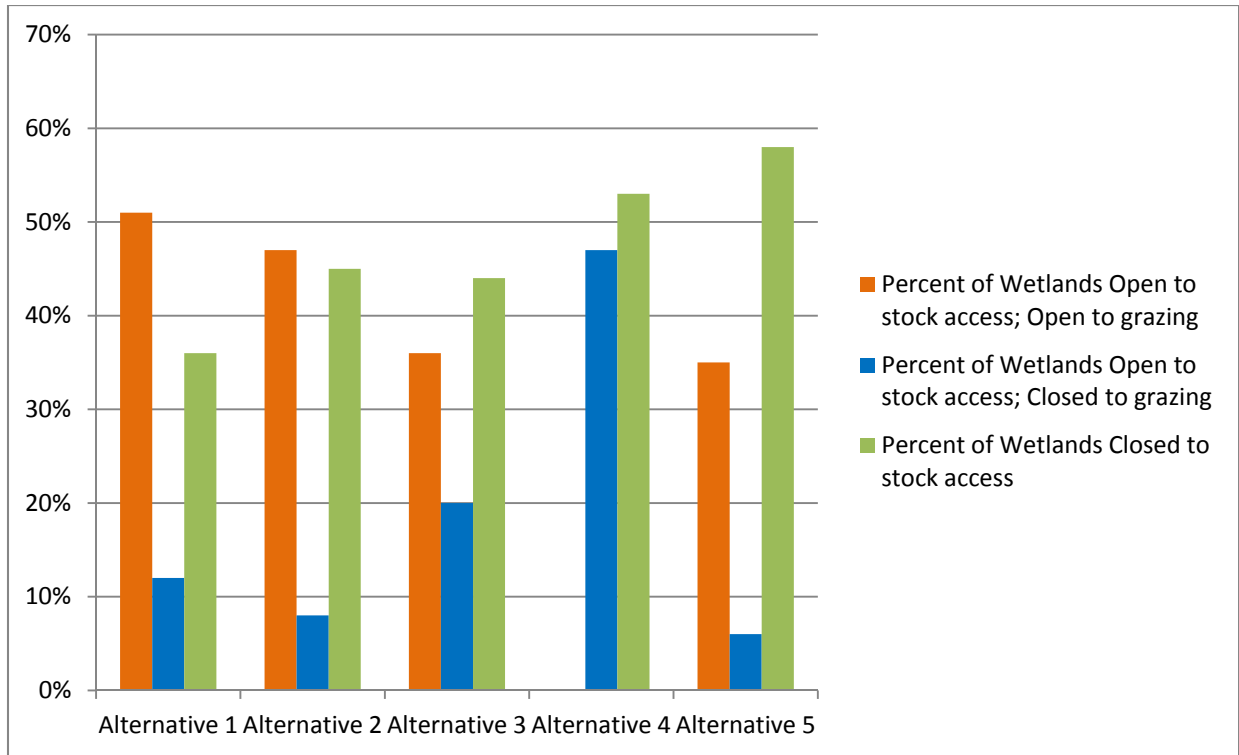
Under all alternatives, impacts on wetlands and meadows would be measurable on a local scale, but in most cases would not be expected to result in significant, long-term changes in function or composition. Alternatives 2 and 5 would result in decreased impacts on meadows from trampling and grazing over those occurring under current conditions; alternative 3 could produce slightly elevated impacts over current conditions. Alternative 4 would eliminate effects from trampling and grazing in meadows throughout the parks’ wilderness, resulting in a significant beneficial effect to wetland and meadow vegetation. All action alternatives would have a beneficial effect on peat-accumulating meadows, ranging from a minor decrease in potential impacts under alternative 2 to a significant decrease in potential impacts under alternative 4. The elimination of grazing, such as proposed under alternative 4, may alleviate effects on wetlands and meadows wilderness-wide, but would likely lead to increased localized impacts by shifting and concentrating use in upland areas where stock would be held and fed.

Continuation of current wilderness management policies, including protection of natural processes, visitor education, and restrictions on amounts and locations of overnight use, would continue to protect wetlands and meadows throughout wilderness. Wetlands and meadows would remain generally undisturbed, with localized exceptions associated with foot traffic and stock use along trail corridors and in those areas used for grazing. Although grazed meadows would be expected to exhibit some differences in productivity, cover, and composition relative to ungrazed meadows, these differences would not be expected to lead to significant long-term changes in productivity, structure or wetland function. Grazing would continue to be routinely monitored to ensure that impacts to vegetation were kept within acceptable levels, impacts to soils remained localized and would not lead to accelerated rates of erosion, and that new introductions of nonnative species were detected and responded to appropriately.

**Table 92: Percentage of Wetlands Open to Stock Grazing, Open to Stock Access, and Closed to Stock Access for All Wetland Types\***

Alternative	Open to Stock Access; Open to Grazing	Open to Stock Access; Closed to Grazing	Closed to Stock Access
Alternative 1	51% (high)	12%	36%
Alternative 2	47%	8%	45%
Alternative 3	36%	20%	44%
Alternative 4	0% (low)	47%	53%
Alternative 5	35%	6%	58%

\*Types of wetlands include lacustrine, palustrine, and riverine wetlands

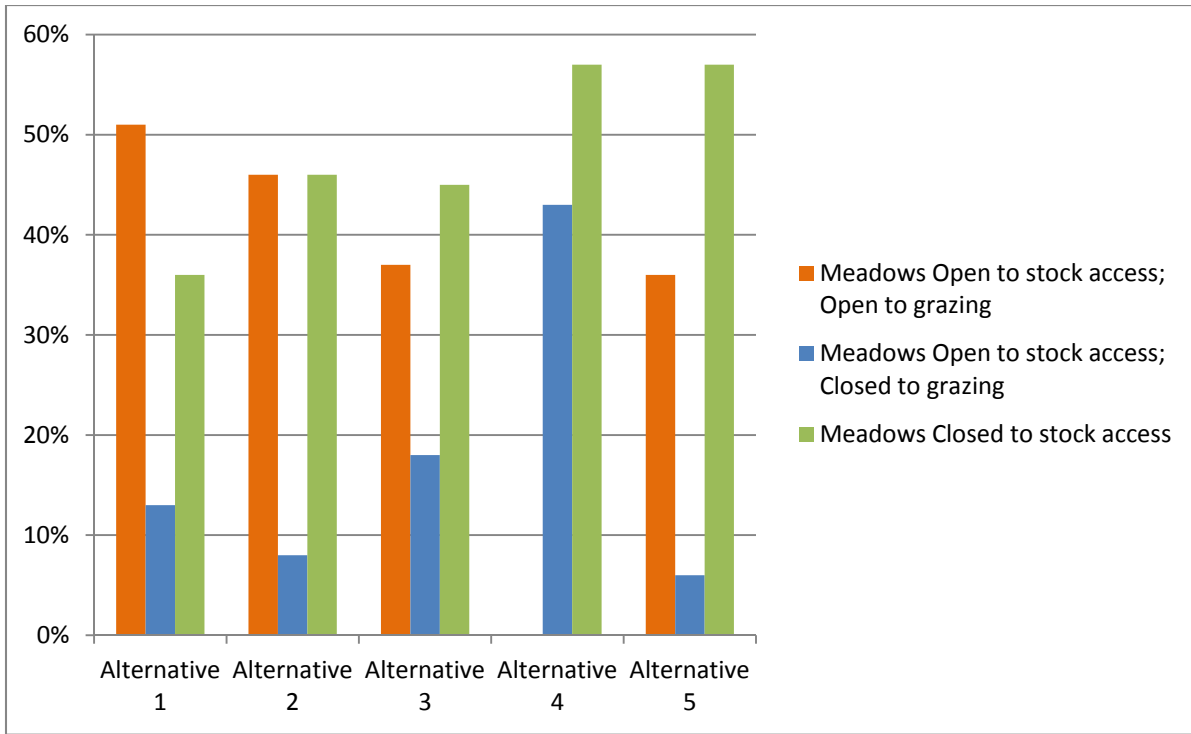


**Figure 32: Percentage of Wetlands Open to Stock Grazing, Open to Stock Access, and Closed to Stock Access for each Alternative**

**Table 93: All Types of Meadows either Open or Closed to Stock Access**

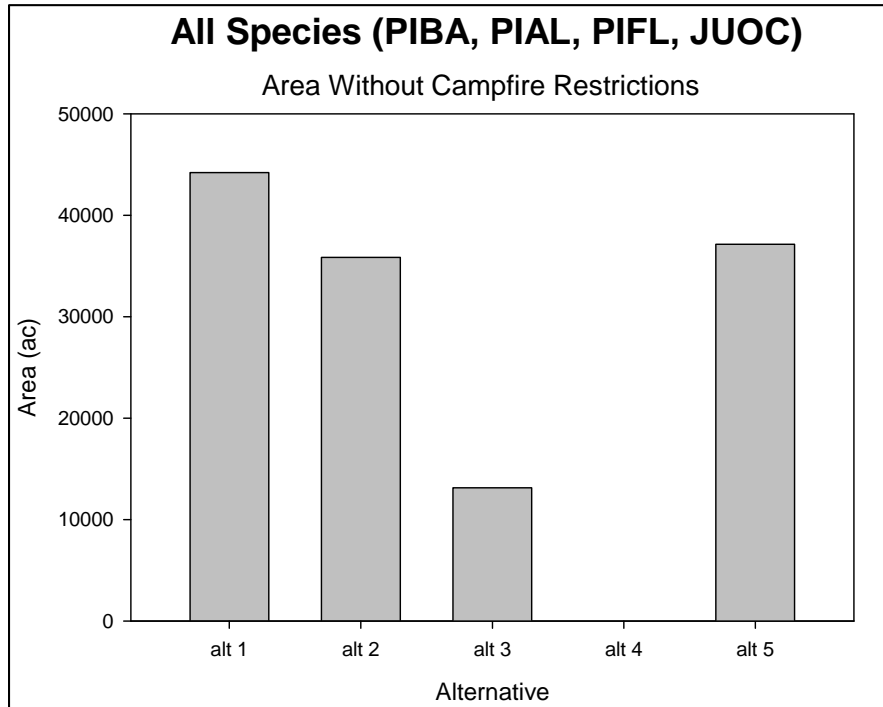
Alternative	Open to Stock Access; Open to Grazing	Open to Stock Access; Closed to Grazing	Closed to Stock Access
Alternative 1	51%	13%	36%
Alternative 2	46%	8%	46%
Alternative 3	37%	18%	45%
Alternative 4	0%	43%	57%
Alternative 5	36%	6%	57%

\*Types of meadows include fens, fen/wet meadows, wet meadows, moist meadows, and dry meadows



**Figure 33: Percentage of Meadows Open to Stock Grazing, Open to Stock Access, and Closed to Stock Access for Each Alternative**

**High-elevation Long-lived Tree Species:** Impacts on high-elevation long-lived tree species were analyzed relative to the elevation restrictions for campfires with affects varying among alternatives. Alternative 1 has the least area with campfire restrictions, while alternative 4 prohibits campfires in the habitats of all four high-elevation conifers (figure 34). Alternative 2 (no campfires above 9,000 feet in Kaweah, Tule, and Soda Springs drainages or above 10,000 feet in Kern, San Joaquin and Kings river drainages) and alternative 5 (restrictions above 10,000 feet) were nearly equivalent for the high-elevation conifer species, with about 2,965 acres more with restrictions under alternative 2 compared to alternative 5. Alternative 3 (restrictions above 9,000 feet wilderness-wide) was intermediate between alternative 4 and alternatives 2 and 5. The differences between the alternatives and species groups are presented in table 94 below. The alternatives range from protecting 65–100% of the high-elevation habitat in the parks from campfires. All of the action alternatives would reduce impacts on high-elevation long-lived trees, and the reduced impacts under alternative 4 would be significant.



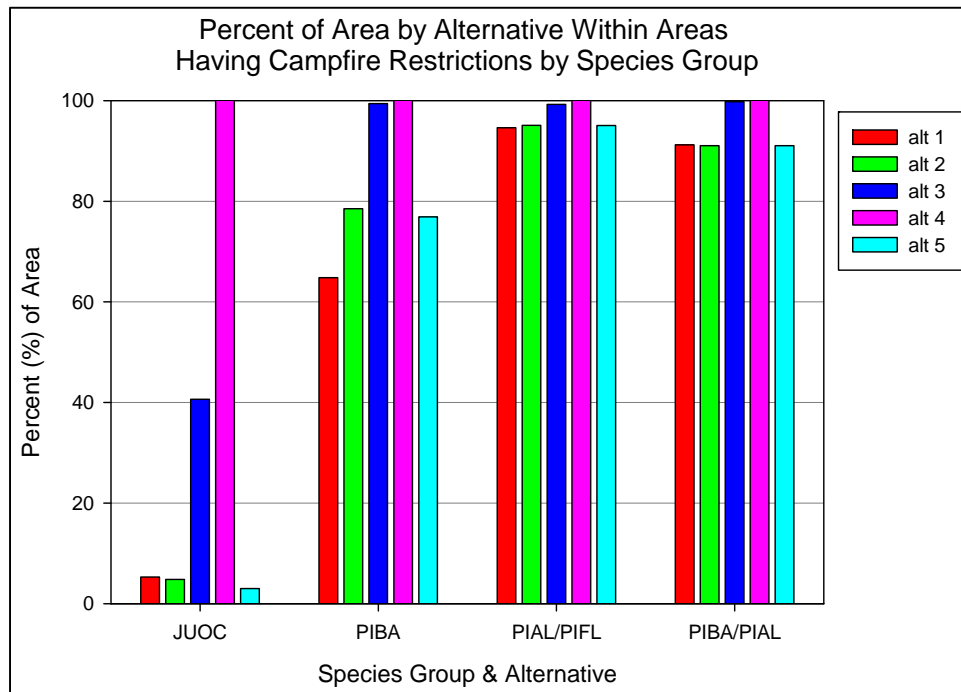
**Figure 34: Combined Acreage Where the Four High-elevation Long-lived Tree Species Grow Where There Are Not Campfire Restrictions (Alternatives 1 through 5)**

The different alternatives will result in differing campfire restriction coverage among the four long-lived species. The differences among the alternatives are greatest for Sierra juniper and smallest for the species groups of whitebark/limber pines and foxtail/whitebark pines. This is a result of the campfire restrictions covering all high-elevation areas across all alternatives, whereas large portions of the mapped distributional range of the largely upper montane Sierra juniper only falls within two of the alternatives; alternative 3 and 4 (figure 35). If only the five-needle species are considered, campfire restriction coverage for alternative 2 and alternative 5 are similar, as are alternative 3 and alternative 5. Area of greatest potential affects from campfires and fuelwood gathering at campsites and along trails (within 328 feet), in areas not having campfire restrictions varied by alternative, with the largest area in alternative 1 (1,893 acres) and smallest in alternative 4 (0 acres) where all campfires are restricted within wilderness. The other alternatives were intermediate with some variation by alternative. Beside the target vegetation classes where campfires would be restricted, the elevational designations specified in the five alternatives will also result in the inclusion of some non-target vegetation classes that fall within the elevational limits. This would include higher elevation portions of the distribution of species such as lodgepole pine and mountain hemlock. The area of non-target vegetation where restrictions would be placed varies by alternative (figure 36). It would be greatest under alternative 4 and smallest under alternative 5.

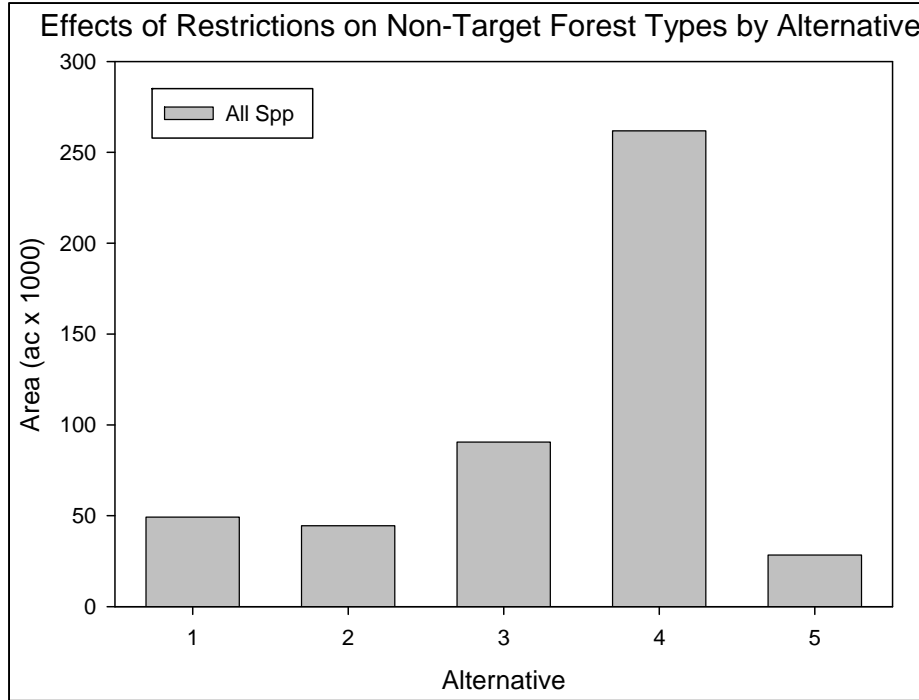
**Table 94: Summary Values by Alternative Regarding Campfire Restrictions**

Alternative	Acres of Subalpine Vegetation* without Campfire Restrictions (Not Protected)	Percent of Total Subalpine Habitat with Campfire Restrictions (Protected)
Alternative 1	44,212	65
Alternative 2	35,857	72
Alternative 3	13,126	90
Alternative 4	0	100
Alternative 5	37,144	71

\*includes the four long-lived tree species: foxtail pine, whitebark pine, limber pine, and western juniper



**Figure 35: Comparison of Percent Area Having Campfire Restrictions for Specific Vegetation Classes (as classed by Sequoia and Kings Canyon National Parks Vegetation Map)**



**Figure 36: Area of Non-target Vegetation Classes that Occur within the Elevational Limits for the Campfire Restrictions for Each of the Five Alternatives**

**Alpine vegetation:** Most of the alpine vegetation in the parks—found in some of the most remote and inaccessible portions of wilderness—is thought to be intact and relatively free from human disturbance. Where visitor use is concentrated, however, the slow-growing, perennial dominated communities that make up the alpine vegetation can show signs of impact. Due to the short growing season and harsh conditions that characterize the high-elevation environment, recovery from even minor disturbances can take a very long time and impacts can thus persist.

Direct removal of alpine vegetation occurs infrequently, and is primarily associated with trail maintenance and construction activities. Under alternatives 1, 2 and 3, impacts resulting from these activities would continue at existing levels, resulting in localized impacts on alpine plants. Reflecting the proposed changes in trail classification and lower use levels anticipated under alternatives 4 and 5, there may be a modest decrease in impacts associated with trail work under those alternatives.

Trampling of alpine vegetation along trail corridors and in high-elevation camp areas by human traffic would continue to occur. While these impacts can be locally severe, they are currently insignificant at the landscape scale and this would be expected to remain the case. The severity and extent of impacts on alpine vegetation would be expected to correlate with the use levels anticipated under each alternative; thus alternatives 1, 2 and 3 would have the potential to result in continued or slightly increased impacts on alpine vegetation, and such impacts would be expected to decrease under alternatives 4 and 5. Most trampling impacts would continue to occur along cross-country routes and in popular destinations where visitor use is concentrated. Areas where such impacts would be expected to continue to be seen under all alternatives would include Dusy Basin, the Mount Whitney area, Upper Darwin Canyon/Lamark Col, Mount Langley, Kearsarge Lakes, and other similar high-elevation basins and routes popular with hikers. Should additional destinations increase in popularity (as periodically occurs in response to news articles,

guidebooks, and information shared through social media) localized trampling impacts in such areas would be expected to increase.

Under alternative 1, with the anticipated increase in visitation to the Mount Whitney area, trampling impacts on alpine vegetation would be expected to increase along all routes leading into and through the area, especially through Miter Basin, Crabtree Pass, and along the JMT corridor. Increased popularity of Mount Langley, as an easily accessed 14,000+ feet peak, would continue to result in impacts on the sparsely vegetated summit area and along the multiple approach routes; however, these are expected to be mitigated by the establishment of a cairned route to the summit in 2014. Similarly, the increased popularity of alpine summits along the crest among ‘peak baggers’ would be expected to lead to increased development of informal trails and trampling of alpine vegetation, both on the summits and along approach routes. With additional controls on visitor use in the Mount Whitney area under the action alternatives, trampling impacts on alpine vegetation would be expected to stabilize in these areas, although the increased use levels anticipated under alternative 3 could lead to an increase in these impacts.

Under all alternatives alpine vegetation would continue to be affected to some extent by visitor activities. The use of administrative and recreational stock would continue to have potential for impact on those alpine meadows open to stock access and/or grazing. Grazing of other alpine vegetation types, such as fell-fields, would be infrequent and associated with pass-through travel and in areas where stock can be held and fed but not grazed. Alternatives 1, 2, 3, and 5 would allow some level of grazing in 14–30% of the mapped alpine vegetation in the parks’ wilderness. Each of these alternatives would prohibit stock access in a portion of the parks’ alpine, ranging from 64% under alternative 1, 69% under alternative 3, 70–76% of the mapped acreage under alternatives 2 and 4, and up to 83% under alternative 5. Grazing of alpine vegetation in the Evolution Lake basin would continue to be restricted to walking parties with burros or llamas. Because these animals have unshod hooves, consume less forage than horses or mules, and are infrequently used as stock in the parks, trampling and grazing impacts on alpine vegetation would continue to be minimal in this area. Trampling impacts on upland alpine vegetation would continue to be largely associated with established trails and routes, since cross-country stock travel through alpine areas is infrequent, and this would not be expected to change significantly under any of the alternatives.

Under alternatives 2, 3 and 5, grazing would be managed according to the Stock Use and Meadow Monitoring and Management Strategy described in appendix D. This would include the application of site-specific grazing capacities to all alpine meadows open to grazing. The use of these capacities would reduce grazing and trampling impacts in the most popular destinations while also providing protection to those areas which otherwise may be subject to increased grazing pressure in response to the implementation of temporary restrictions nearby. Under current use levels and patterns, grazing impacts would continue to be most detectable in popular meadows along the JMT, and in those areas serving as foci for trail crews.

Under alternative 4, grazing would be prohibited and trampling of alpine meadows currently open to grazing would largely cease, although low levels of trespass grazing and trampling would be expected. The removal of all drift fences and gates would mean that animals who became untethered would likely roam farther afield than under current conditions, with a possible increase in off-trail trampling impacts as a result. These would be expected to be infrequent. Stock access would be prohibited in 76% of the mapped alpine vegetation, the second-highest level of protection afforded by any of the alternatives.

Under current (alternatives 1 and 2) or reduced (alternatives 4 and 5) use levels and patterns, vegetation in untrailed alpine areas would remain largely undisturbed. Any significant increase in levels of use or change in patterns of visitor use, as that anticipated under alternative 3, would be expected to result in increased trampling and/or grazing impacts on alpine vegetation. The implementation of campsites



condition standards and visitor encounter standards under the action alternatives would serve for the detection and management of such impacts, allowing for the continued protection of alpine vegetation throughout the parks' wilderness.

**Table 95: Summary Values for Alpine Vegetation by Alternative Related to Stock Access**

Alternative	Open to Stock Access and Grazing	Open to Stock Access, Closed to Grazing	Closed to Stock Access
Alternative 1	30%	6%	64%
Alternative 2	27%	3%	70%
Alternative 3	15%	16%	69%
Alternative 4	0%	24%	76%
Alternative 5	14%	3%	83%

Continuation of current wilderness management policies, including protection of natural processes, visitor education, and restrictions on amounts and locations of overnight use, would continue to protect alpine vegetation throughout the wilderness. Alpine vegetation would remain generally undisturbed, with localized exceptions associated with foot traffic and stock use along trail corridors, in high elevation camps, and in alpine areas used for grazing. Although grazed meadows would be expected to exhibit some differences in productivity, cover, and composition relative to ungrazed meadows, these differences would not be expected to lead to significant long-term changes in the productivity, structure or function of alpine systems. Grazing would continue to be routinely monitored to ensure that impacts to vegetation were kept within acceptable levels, impacts to soils remained localized and would not lead to accelerated rates of erosion, and that new introductions of nonnative species were detected and responded to appropriately.

**Plants of Conservation Concern (Park Sensitive Plant Species):** Under all of the alternatives, direct removal of plants of conservation concern would be expected to occur only under very limited circumstances, such as collections made in the course of research, inventory, or monitoring activities. Collection of voucher specimens is strictly regulated through the research permitting and environmental compliance processes to prevent population level impacts. Because the species of concern are by definition rare, the likelihood that they would be encountered by visitors and illegally collected is considered quite low.

Similarly, trampling of the plants of conservation concern by hikers would be expected to be infrequent under the patterns of use anticipated under alternatives 1, 2, 4 and 5. Although species in the meadows and uplands may continue to suffer incidental trampling by visitors traveling through meadows or on cross-country routes, this would not be expected to result in population level impacts.

The potential for trampling of the plants of conservation concern by hikers could rise with the increased levels and patterns of use anticipated under alternative 3. Species in the meadows and uplands may be subject to incidental trampling by visitors traveling through meadows or on cross-country routes. Although this would not be expected to result in population-level impacts, the likelihood of local impacts would increase commensurate with increasing use levels. The closure of the Baxter Pass Trail to stock would lead to increased protection of populations of *Astragalus ravenii* and *Streptanthus gracilis* in that area. Thus potential for impacts on the seven vascular plant species of conservation concern known or suspected to occur in alpine upland areas frequented by cross-country hikers and used occasionally by stock, would be expected to increase.

If recreational rock climbing on the walls of the South Fork Kings River were to increase with the proposed opening of the North Dome area to overnight camping under alternatives 2, 3, 4 and 5, incidental impacts on individuals of marble rockmat, which grows in crevices and on ledges in the canyon, could be expected to increase. An increase in the use of existing routes and the development of additional new routes could lead to locally significant trampling impacts which could have measurable impacts on local populations. As the species is also found in remote, off-trail areas not favored by climbers, such impacts would not be expected to result in large-scale losses or declines that could lead to the listing of the species.

Impacts on the seven vascular plant species of conservation concern known or suspected to inhabit areas that would remain open to cross-country travel by stock under alternatives 1, 2, 3 and 4 would be expected to remain localized and insignificant at the population level. Exceptions to this are found along the floor of the lower Kern Canyon (where administrative grazing of the area known as the 'maze' coincides with the habitat of Kern River daisy), and on the Hockett Plateau (where administrative stock tend to roam off trail and can potentially encounter populations of Tulare County bleeding heart, field ivesia, Hockett Meadows lupine, and purple mountain-parsley). Continued administrative grazing in these areas would not be expected to result in population-level impacts, large-scale losses, or declines that could lead to the listing of these species.

Under alternatives 1, 2, 3, and 5 the 18 vascular plant species of conservation concern either known, or having the potential, to grow in or adjacent to meadows that would remain open to grazing by stock would continue to be exposed to potential impact from grazing. Under alternatives 2, 3 and 5 grazing intensity in meadows would be managed through the implementation of site-specific grazing capacities, and thus impacts on these species would continue to be localized and would not be expected to result in large-scale losses or declines that could lead to the listing of any of the species.

The potential for such localized impacts would be expected to increase in frequency and extent with the increase in use anticipated under alternative 3, while the holding and feeding of animals in camps adjacent to meadows that would occur under alternative 4 also has the potential to result in increased localized impacts on plants of conservation concern. With continued monitoring and management of visitor and administrative use, such impacts would not be expected to result in large-scale losses or declines that could lead to the listing of the species.

The mosses of concern considered in this analysis (*Bruchia bolanderi*, *Helodium blandowii*, *Meesia triquetra*, *Meesia uliginosa*, and *Pohlia tundrae*) all grow in meadow environments. Specific actions proposed under all of the action alternatives that would lead to greater protection of these species from trampling and grazing impacts include the closure of the Lower Big Arroyo and Guyot Creek east of the JMT, which would protect the peat-accumulating wetlands there and the associated moss flora from impacts. Expanding the portion of the Miter Basin area open only to pass through and day rides by stock, coupled with the adoption of smaller party sizes for off-trail hikers and riders, would potentially provide additional protection to the habitat of tundra thread moss. The implementation of grazing capacities for all park meadows under alternatives 2, 3, and 5 would also afford greater protection to the moss communities found in peat-accumulating wetlands. The parks-wide grazing prohibition proposed under alternative 4 would afford the greatest level of protection to mosses found in meadows.

Under each of the alternatives considered under this plan, impacts on plants of conservation concern would be expect to remain localized and insignificant at the population level with proper monitoring and mitigation efforts. None of the actions considered would be expected to lead to large-scale losses or declines that could lead to the listing of these species.

**Nonnative plant species:** Alternative 1 allows the most extensive off-trail stock travel and grazing, producing the highest probability of introducing nonnative plants in areas where early detection would be difficult and costly. Stock use and disturbance severity under alternative 1 is slightly higher than alternatives 2 and 3, and much higher than alternatives 4 and 5. Disturbance related to visitor use (trail use quotas and group size) and facility maintenance (trail construction and maintenance, ranger station maintenance) would produce similar nonnative plant impacts as alternatives 2 and 3, but higher impacts than alternatives 4 and 5. Due to the continued allowance of unprocessed stock feeds (hay and hay cubes) into the wilderness, overall propagule pressure would continue to produce a substantial risk of introducing new invasive plant species and populations. Alternative 1 would have the highest probability of introductions to high-value habitats (wetlands) among all of the alternatives. Spatial distribution of impacts would be wide, and difficulty of detection would be highest among all the alternatives.

The probability of successful nonnative plant introduction and establishment can be predicted by estimates of propagule pressure and disturbance, which can be measured by levels of stock access, visitor use, and facility maintenance. Alternatives 1, 2, and 3 have overall similar levels of stock access, visitor use, and facility maintenance, so the probability of successful nonnative plant introductions and establishment by these measures are not expected to differ greatly. However, implementation of stock-feed regulations and improved prevention mitigations would reduce, but not eliminate, propagule introductions associated with stock use for all alternatives. In addition, alternatives 4 and 5 have reduced levels of stock access, visitor use, and facility maintenance, so the probability of successful nonnative plant introductions and establishment would be substantially reduced, resulting in substantial beneficial effects on native plant communities. Alternative 4 would additionally eliminate grazing in meadows, substantially reducing the risk of nonnative plant introductions and establishment in mid-elevation meadows, which are trending toward increased incidence of invasive perennial grasses such as velvet grass, orchard grass, smooth brome, and reed canarygrass. By reducing or eliminating stock access outside trail corridors, alternatives 4 and 5 would reduce the total area requiring early detection surveys and allow early detection resources to be used more effectively, so the probability of detecting new introductions early would be higher. In summary, none of the alternatives would result in additional negative impacts from nonnative plant species. Alternative 2 would have slight beneficial effects, and alternatives 4 and 5 would have substantial beneficial effects by reducing nonnative-plant introductions and establishment; with alternative 4 offering the most improvement.

## **WILDLIFE**

### **METHODOLOGY FOR ANALYZING IMPACTS**

The NPS Organic Act, which directs parks to conserve “wild life” unimpaired for future generations, is interpreted to mean that native animal life should be protected and perpetuated as part of the parks’ natural ecosystems. Natural processes are relied on for the maintenance of populations of native species to the greatest extent possible, and these species are protected from harvesting, harassment, or harm by human activities. According to NPS *Management Policies 2006*, the restoration of native species is a high priority (section 4.1). Management goals for wildlife include maintaining components and processes of naturally evolving park ecosystems, such as natural abundance, diversity, and the ecological integrity of plants and animals.

Impacts to wildlife were assessed by reviewing existing literature and characterizing the effects based on the types of impacts that could occur, and the analyzing factors that could contribute to wildlife impacts under each alternative. The types of impacts associated with wildlife that relate to visitor use and administrative activities in wilderness include wildlife behavior modification and habitat modification. These are described in the following paragraphs.

## **TYPES OF IMPACTS ON WILDLIFE**

Knight and Cole (1991) describe four ways that recreational activities impact wildlife: harvesting, habitat modification, pollution, and disturbance. Because harvest is not allowed in the parks, with the exception of highly regulated collections for research purposes, it is unimportant in the context of this WSP/DEIS and will not be discussed further. Habitat modification and pollution are similar enough to each other that they will be discussed collectively under “Habitat Modification.” Because the primary impact of disturbance is that it causes changes in wildlife behavior, disturbance will be discussed under “Behavior Modification.” Thus, there are essentially two general forms of wildlife impacts caused by human activities in the parks’ wilderness: impacts on wildlife behavior and impacts on wildlife habitat.

**Behavior Modification:** Wildlife respond to encounters with visitors in one of three ways: avoidance, attraction, and habituation (Knight and Cole 1991). Avoidance is often a short-term response to disturbance, such as individuals exhibiting flight responses after encounters with recreationists and then resuming their prior activities soon thereafter. Avoidance can also be a long-term response to disturbance, such as individuals permanently avoiding otherwise suitable habitat in favor of undisturbed sites. Attraction develops over time when wildlife seeks out humans because of positive reinforcement, such as food rewards. Habituation (i.e., bears foraging for natural foods in close proximity to people after learning that people are non-threatening) develops over time after frequent benign encounters with humans, in which there is no positive or negative reinforcement; animals ignore humans to avoid energetically costly irrelevant behavior. Responses to the same disturbance may vary between species, between individuals within a species, or even between the same individual across different encounters. It is important to recognize that while these three types of behavioral responses may be adaptive and “natural,” they may not necessarily be desired. For example, habituation of bighorn sheep to humans may be desirable to facilitate co-existence of the two species, while habituation of bears to humans may be undesirable because it often leads to bears obtaining human food and becoming threats to public safety.

Bears that become habituated to humans would be more likely to become food-conditioned (i.e., bears would directly seek out humans as a source of food), either through intentional (e.g., visitors purposely feeding bears) or unintentional means (e.g., visitors accidentally leaving food unsecured) (Herrero 1985). Habituation and food-conditioning would be most pronounced in areas where quality bear habitat and relatively high levels of human use overlap (e.g., Paradise Valley) and as a result, human/bear conflicts would tend to be most pronounced in these areas.

**Habitat Modification:** Habitat modification describes changes to vegetation, soils, and topography as well as pollution that occur as a result of human activities. Habitat modifications are generally considered adverse for most species, but they can also cause simultaneous beneficial effects on other species. For example, facilitation or development of stock facilities and stock grazing may be beneficial to brown-headed cowbirds but adverse to the host species that would be parasitized by brown-headed cowbirds (Rothstein et al. 1980). There is some disagreement in the literature regarding the severity of impacts of brown-headed cowbird parasitism to host species in the Sierra Nevada. Rothstein et al. (1980) found high levels of brown-headed cowbird parasitism in developed areas of the Sierra Nevada and suggested that parasitism rates were high enough to threaten the continued survival of some species. However, Verner and Ritter (1983) concluded that brown-headed cowbirds were largely absent in natural areas of the Sierra Nevada and doubted that brown-headed cowbird parasitism was a substantial threat. Purcell and Verner (1999) arrived at a similar conclusion. Additional evidence for the latter hypothesis is that Siegel and Wilkerson (2005) found little evidence of cowbird presence within the parks’ wilderness specifically, with most detections occurring near developed areas. Halterman et al. (1999) examined brown-headed cowbird parasitism rates in eight western national parks, including Sequoia and Kings Canyon National Parks, and considered the overall parasitism rate of 6.6% to be low. The observed rate in the parks was 2.9%. These lines of evidence suggest that brown headed-cowbird impacts on host species in the parks

would be unlikely to threaten the continued survival of any species, although the situation may be substantially different outside of the parks.

On the other hand, the study by Halterman et al. (1999) is now 15 years old and despite showing declines in abundance Sierra-wide, there is a trend (although not statistically significant) indicating that brown-headed cowbird abundance has increased in the parks over the past several decades (Steel et al. 2012). Thus, while impacts on bird species parasitized by brown-headed cowbirds would be adverse, there is insufficient information available to determine impact intensity with complete certainty. The best available evidence suggests that brown-headed cowbird impacts are unimportant in influencing native bird population dynamics within the wilderness of the parks, but may be important in frontcountry areas for species restricted to lower elevations, where brown-headed cowbirds are more abundant.

Light to moderate stock grazing may decrease habitat quality for some invertebrate species but increase habitat quality for others (González-Megías et al. 2004). The impacts would generally be more pronounced in (1) meadows that receive higher levels of grazing compared to meadows that are rarely or lightly grazed and (2) wetter sedge habitats than in drier reed habitats (Holmquist et al. 2013a). Stock generally do not graze an entire meadow evenly because of variation in forage quality throughout a meadow. In patches that are heavily grazed, most (if not all) invertebrate species would be adversely impacted, but some invertebrate species may experience beneficial effects in areas that are lightly grazed, perhaps because of (1) an increase in the diversity of available habitats, (2) provision of supplemental food (i.e., manure), or (3) damage to plants making them more susceptible to insect herbivory (Holmquist et al. in press). Within the growing season, impacts would be minimal, characterized by Holmquist et al. (2013b) as “neither completely benign nor vastly destructive.”

The minimal impacts from a previous year would be unlikely to persist into the following year (i.e., annual cycles of invertebrate community disturbance followed by reorganization would likely occur). For example, Holmquist et al. (2010) found that within the parks, at the beginning of the growing season and prior to stock arrival, there were few differences in invertebrate diversity and abundance between meadows with a long history of stock use and meadows with a long history of minimal use. Thus, there would be few, if any, long-term impacts (beneficial or adverse) to invertebrates due to stock grazing.

Impact intensity would be scale dependent. At the scale of the overall wilderness, stock grazing impacts on invertebrates would be undetectable because of the small area impacted. On a localized scale, measurable impacts would occur.

## **FACTORS THAT CONTRIBUTE TO WILDLIFE IMPACTS**

The primary factors that contribute to wildlife behavior modification include encounters between wildlife and hikers and stock (from either recreational or administrative sources) because these are the types of disturbances that occur most frequently. Secondly, wildlife behavior could be modified by infrequent administrative activities such as helicopter flights. The primary factors that contribute to wildlife habitat modification include grazing by stock, trampling by humans and stock, nutrient loading from human and stock waste, and creation or maintenance of infrastructure that supports visitor recreation (e.g., trails, campsites, ranger stations, food-storage boxes, etc.).

## **IMPACTS OF ALTERNATIVE 1: NO-ACTION / STATUS QUO**

**Black Bears:** Under alternative 1, bears would continue to have benign encounters with people throughout wilderness, which would lead to habituation. Incident rates would likely continue to remain near their current level, which is substantially lower than neighboring Yosemite National Park (NPS n.d. b). There would likely be periodic fluctuations because of variation in natural food supplies (e.g., incidents would likely be higher in years of poor natural food availability), but as a rule, incidents would

continue to remain relatively rare, and bear population dynamics in wilderness would be dominated by natural processes.

**Cumulative Effects:** Past, present, and reasonably foreseeable actions occurring within the parks and the surrounding area that would be expected to contribute to cumulative impacts to bears include implementation of the parks' Bear Management Plan and Fire and Fuels Management Plan; land management plans for the adjacent USFS lands; and bear hunting on both public and private land adjacent to the parks. Bear management activities under the Bear Management Plan generally occur in the frontcountry, but may affect bears that use wilderness areas. Some of these activities (e.g., hazing, capturing and tagging, and euthanasia) would adversely impact individual animals in the short-term but would not likely have population-level effects. Other bear management activities (e.g., visitor education, food-storage regulation, law enforcement, etc.) would beneficially impact individuals as well as provide a population-level benefit, both in the short and long-term if these activities led to decreased encounters. The parks' Fire and Fuels Management Plan and land management plans for the adjacent USFS lands would impact bears primarily through modifications of habitat (e.g., prescribed fires, silvicultural treatments, etc.) which could be beneficial or adverse, depending on the specific situation. These impacts would be both short and long term. Bear hunting would adversely impact individual bears that are harvested but there would be no long-term population-level impacts, because harvest rates are maintained at a conservative level. Since alternative 1 proposes no changes to the management of black bears in wilderness, there would be no significant cumulative effects associated with the alternative.

**Birds:** Brown-headed cowbirds would continue to parasitize the nests of dozens of host species, particularly flycatchers, vireos and warblers (Steel et al. 2012). Brown-headed cowbird abundance and parasitism rates could be relatively high near frontcountry developments (e.g., campgrounds, picnic areas, administrative and stock facilities, etc.). These areas are prime foraging areas for brown-headed cowbirds because of access to supplemental food associated with human occupancy (Rothstein et al. 1980, Verner and Ritter 1983). Most native bird species have widespread distributions and would not experience effects substantial enough to alter their population dynamics, but impacts on species with distributions limited to the lower elevations of the parks, such as the yellow warbler, could limit population growth (Rodney Siegel, pers. comm., 2014). In wilderness, brown-headed cowbird abundance and parasitism would be uncommon, and impacts on native bird species would be minimal because of the lack of development, although there could be potential for localized problematic areas near ranger stations or other highly visited sites (see for example, Wright 1999).

**Cumulative Effects:** Past, present, and reasonably foreseeable actions occurring within the parks and the surrounding area that would be expected to contribute to cumulative impacts to brown-headed cowbirds, and therefore, native birds, include implementation of land management plans for the adjacent USFS lands and development on adjacent private lands. In both cases, should habitat fragmentation and human development increase, brown-headed cowbirds would benefit, which may result in an increase in nest parasitism on native birds. Park projects that may affect native birds that are separate from projects proposed by this WSP/DEIS include the restoration of Halstead and Cahoon Meadows, the ecological restoration program, and permitted research projects. Several native bird species that use meadow habitats are known to inhabit the parks, including orange-crowned warbler (*Vermivora celata*), yellow warbler (*Dendroica petechia*), Nashville warbler (*Vermivora ruficapilla*), and Wilson's warbler (*Wilsonia pusilla*) (Wilkerson and Siegel 2002); yellow warbler are common host species of the brown-headed cowbirds (Heath 2008). The meadow restorations would recreate natural habitat that would benefit birds that use the habitat. The resources management and science program would restore natural conditions to human-disturbed areas; this program would benefit wildlife throughout the parks, including birds. Permitted research activities throughout wilderness cover a variety of resources, including wildlife, and specifically birds. Research projects may temporarily disturb birds, but overall the knowledge gained would be beneficial and could be applied to wildlife management plans.

Brown-headed cowbirds would continue to produce adverse impacts on native bird species under alternative 1. However, because this alternative proposed no changes to the management of brown-headed cowbirds in wilderness, there would be no significant cumulative effects associated with the alternative.

**Invertebrates:** Terrestrial invertebrates would continue to be adversely affected by human and stock trampling, particularly along trails, by stock grazing within meadows, and at stream fording sites.

*Trampling* –Terrestrial invertebrate diversity and abundance would be reduced in trampled areas relative to the immediate surrounding areas, due to invertebrate behavioral avoidance of "edge" habitat in favor of core habitat (Holmquist 2004). These adverse impacts would be more pronounced in heavily trampled areas (e.g., maintained trails, campsites, etc.) compared to lightly trampled areas (e.g., informal trails). In heavily trampled areas, impacts would be likely to persist from year to year, and in lightly trampled areas, annual cycles of invertebrate community disturbance followed by reorganization would likely occur. Assuming that a 16.4 feet "zone of influence" around trampled areas is representative (Holmquist 2004), a rough estimation of the area that would be considered heavily trampled is 2,578 acres (0.31% of the area of the parks; based on 650 miles of maintained trails). Impact intensity would be scale dependent. At the scale of the overall wilderness, trampling impacts would be undetectable because of the small area impacted; on a localized scale, measurable impacts would occur.

*Stock grazing* –Stock grazing in meadows would continue to impact invertebrates by causing changes to plant species composition or through changes in habitat structure (Gibson et al. 1992).

*Stock fording of streams* –Stock activity at fording sites would continue to cause soil erosion, sedimentation, and urine and manure deposition (McClaran and Cole 1993), which would likely adversely impact aquatic invertebrates downstream from these sites. It is currently unknown what extent these impacts would be and how long they would persist, but research to address these questions in the Sierra Nevada is ongoing. Extrapolation to the parks' wilderness from similar studies evaluating cattle impacts on aquatic invertebrates [for example, Herbst et al. 2012] is of limited value because stock use of the parks' wilderness streams would be orders of magnitude lower than what occurs on cattle grazing allotments. With the noted caveat of an absence of supporting data, a "best guess" estimation of stock impacts at fording sites to aquatic invertebrates is that they would be similar to grazing impacts: (1) impacts from a previous year would be unlikely to persist into the following year (i.e., annual cycles of invertebrate community disturbance followed by reorganization would likely occur) and (2) impact intensity would be scale dependent—at the scale of the overall wilderness, impacts would be undetectable because of the small area impacted; on a localized scale, measurable impacts would occur. Additionally, measurable impacts would likely only occur at a few fording sites that receive relatively heavy use; no measurable effects would be expected at the more numerous light to moderately used sites.

**Cumulative Effects:** Past, present, and reasonably foreseeable actions occurring within the parks and the surrounding area that would be expected to contribute to cumulative impacts to invertebrates include implementation of the parks' Fire and Fuels Management Plan and various restoration programs (e.g., Aquatic Restoration Plan, Halstead and Cahoon Meadow restorations, etc.). The implementation of the parks' Fire and Fuels Management Plan would impact invertebrates primarily through modifications of habitat (e.g., prescribed fire), which could be beneficial or adverse depending on the specific situation. These impacts would generally be short-term. Restoration programs would provide long-term beneficial impacts to invertebrates. For example, the meadow restoration program would recreate natural conditions including water flow and native plants, creating suitable conditions for native invertebrates. Permitted research activities throughout wilderness cover a variety of resources, including wildlife. Invertebrate studies are one of the most frequent topics for research projects in the parks in the last three years. Research projects may temporarily disturb invertebrates depending on the methods of tracking and

collecting data, but overall, the knowledge gained would be beneficial and could be applied to wildlife management plans.

Because this alternative proposed no changes to hiker and stock use in wilderness, there would be no significant cumulative effects associated with the alternative.

## **IMPACTS OF ALTERNATIVE 2: PROTECT WILDERNESS CHARACTER BY IMPLEMENTING SITE-SPECIFIC ACTIONS (NPS PREFERRED ALTERNATIVE)**

**Black Bears:** In popular use areas visitor use levels would be similar to present levels. Keay and van Wagtenonk (1983) found that human/bear conflicts and visitor density (measured as visitors present per night in each management zone) in wilderness areas of Yosemite National Park were correlated with each other, whereas other measures of visitor use (e.g., the distance and number of days hiked from trailhead to trail zone; the number of trail segments in a zone; the length of trails in a zone; and the number of camp areas per zone) did not correlate with human/bear conflicts. Because the visitor use levels would be similar to present levels, there would be little change in undesirable bear behavior as a result of this action.

On the other hand, the removal of 26 food-storage boxes, as well as potentially an additional 13 over time may result in an increase in food-conditioning and resultant human/bear conflicts near these sites relative to alternative 1, especially if visitors do not properly use alternative approved food-storage measures. However, because the food-storage boxes selected for removal would be in areas without a history of bear issues; where a nearby food-storage box would be sufficient for storage needs; where container requirements would likely be successful; or where there would be opportunities for counter-balancing, increases in human/bear conflicts as a result of this action would be expected to be minimal. The establishment of additional designated campsites in bear habitat, assuming that this action results in an increased concentration of visitor use, could also result in an increase in food-conditioning and human/bear conflicts near these sites. This would occur due to increased human/bear encounter rates that foster bear habituation to people which, as discussed previously, could be a precursor to behavior and food-conditioning. Increased density of human food in these locations could also result in increased human/bear conflicts. If proper food storage is regularly practiced, increases in human/bear conflicts as a result of this action would be expected to be minimal.

It is likely that any change (positive or negative) in human/bear conflict rates under alternative 2 would be minimal.

**Cumulative Effects:** Other than those ongoing projects and activities associated with the administration of wilderness (i.e., facility and visitor-use management), there are few past, present, or future foreseeable projects in the parks' wilderness that have a detectable effect on black bears. The impacts from the implementation of the parks' Bear Management Plan and Fire and Fuels Management Plan, land management on adjacent USFS lands, and bear hunting actions outside the parks would be the same as previously described for alternative 1. This alternative would result in impacts that are not substantially different from the status quo (alternative 1), with some localized adverse impacts where designated campsites would be established. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

**Birds:** The closure of additional meadows to grazing could contribute to reduced habitat quality for brown-headed cowbirds, and thus could also result in a decrease in parasitism to host species near these sites, relative to alternative 1. At other sites, the establishment of designated stock camps (assuming that this action results in an increased concentration of stock use) could result in increased habitat quality for



brown-headed cowbirds, and therefore, increases in parasitism to host species near these sites. However, as discussed previously, because existing parasitism rates, based on the best available evidence, are thought to be unimportant in influencing native bird population dynamics in wilderness, impacts on native birds by these actions (adverse or beneficial) would likely be minimal. Also at the park-wide scale, the requirement that stock feed carried into wilderness be limited to processed pellets or rolled grains could result in increases in brown-headed cowbird abundance and parasitism rates because it is likely that processed pellets and rolled grains that are not completely consumed by stock would be used as a supplemental food source by brown-headed cowbirds. Again however, this conclusion is speculative.

Because frontcountry areas are already developed, it is unlikely there would be measurable increases in brown-headed cowbird abundance associated with the modification of any of the frontcountry developments of stock camping sites in Cedar Grove, possible modification of stock facilities in Wolverton, modification of the Atwell Mill Campground for stock camping, possible modification of stock facilities at the Mineral King pack station, and modification of the South Fork Campground for stock camping. Discussing the relationship between development and brown-headed cowbirds, Verner and Ritter (1983) stated, “*Unless future developments are confined to areas already developed* [emphasis added], they will no doubt increase the abundance and distribution of cowbirds in the mountains.” Based on this rationale, while brown-headed cowbird abundance may increase slightly at these sites, particularly because they would be closer to source populations than wilderness sites, it seems reasonable to assume that significant adverse impact on host species through parasitism, relative to alternative 1, would not be expected.

**Cumulative Effects:** Cumulative effects would be similar to those described under alternative 1. This alternative would result in impacts that are not substantially different from the alternative 1 with localized adverse impacts where new campgrounds would be established and development of stock-related features at Cedar Grove, Wolverton, Atwell Mill, and Mineral King. There are both adverse and beneficial effects as a result of ongoing and future potential projects. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect on native birds.

#### **Invertebrates:**

*Trampling* – Similar visitor use levels would result in similar trampling impacts on invertebrates as alternative 1.

*Stock grazing* –The closure of additional meadows to grazing could provide beneficial effects on invertebrates at these sites relative to alternative 1, but because Holmquist et al. (2010) found that within the parks’ wilderness, at the beginning of the growing season and prior to stock arrival, there were few differences in invertebrate diversity and abundance between meadows with a long history of stock use and meadows with a long history of minimal use, beneficial effects would likely be minimal. Beneficial effects would be most pronounced in the newly closed meadows that previously experienced higher levels of grazing.

*Stock fording of streams* – Impacts on aquatic invertebrates downstream from fording sites would be similar to those described under alternative 1. There would be no actions under alternative 2 that would measurably modify the frequency that streams would be forded by stock.

**Cumulative Effects:** Cumulative effects would be similar to those described under alternative 1. This alternative would result in impacts that are not measurably different from the status quo (alternative 1). Considered together, there would be no meaningful additive or interactive effects among these projects

and the proposed actions under this alternative that would constitute a significant cumulative effect on invertebrates.

### **IMPACTS OF ALTERNATIVE 3: PROVIDE MORE OPPORTUNITIES FOR PRIMITIVE RECREATION**

**Black Bears:** In popular use areas for which visitor use levels could increase, bears may have more frequent benign encounters with people, which may lead to an increased frequency of habituation and food-conditioning relative to alternative 1. The establishment of additional designated campsites in bear habitat, assuming that this action results in an increased concentration of visitor use, could also result in an increase in food-conditioning and resultant human/bear conflicts near these sites.

On the other hand, these adverse consequences would be at least partially, perhaps completely mitigated by the addition of up to 35 new food-storage boxes, shifting locations of existing food-storage boxes to key areas, and modifying food-storage requirements, including adding portable container requirements in selected areas.

**Cumulative Effects:** The majority of other past, present, and future foreseeable projects in wilderness have little potential for effects on black bears. The impacts from the implementation of the parks' Bear Management Plan and Fire and Fuels Management Plan, land management on adjacent USFS lands, and bear hunting actions outside the parks would be the same as previously described for alternative 1. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

**Birds:** The closure of the meadows to grazing in the off-trail areas could contribute to reduced habitat quality for brown-headed cowbirds, and thus could result in a decrease in parasitism to host species near these sites, relative to alternative 1. Actions that could benefit brown-headed cowbird include establishment of designated stock camps, frontcountry development, and the requirement of using processed pellets, rolled grains, or fermented hay as stock feed. Impacts within both the wilderness and the frontcountry would be similar to alternative 2, as the relevant actions proposed are nearly identical. Based on the rationale detailed in alternatives 1 and 2, that brown-headed cowbird parasitism is unimportant in influencing native bird populations, adverse impacts on native bird populations from alternative 3 would likely be minimal.

**Cumulative Effects:** This alternative would result in impacts that are not substantially different from alternative 1, with localized adverse effects from additional frontcountry stock facilities. Cumulative impacts would be similar to those described under alternative 1. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect on native birds.

#### **Invertebrates:**

*Trampling* – Increases in visitor use may provide additional adverse trampling impacts on invertebrates relative to alternative 1, but the difference would likely be slight because existing trampled areas (e.g., maintained trails, campsites, etc.) would remain in that state regardless of the frequency of visitor use. Invertebrates in lightly trampled areas (e.g., informal trails) may experience additional adverse consequences as a result of increased visitor use, but impacts would be unlikely to persist from year to year; annual cycles of invertebrate community disturbance followed by reorganization would likely occur.

*Stock grazing* –The closure of additional meadows in off-trail areas to grazing could provide beneficial effects on invertebrates at these sites relative to alternative 1. However, because Holmquist et al. (2010)

found that there were few differences in invertebrate diversity and abundance between meadows with a long history of stock use and meadows with a long history of minimal use, beneficial effects would likely be minimal. Beneficial effects would likely be most pronounced in the newly closed meadows that previously experienced relatively higher levels of grazing.

*Stock fording of streams* – Impacts on aquatic invertebrates downstream from fording sites would be similar to alternative 1. There would be no actions under alternative 3 that would measurably modify the frequency that streams would be forded by stock.

**Cumulative Effects:** Cumulative effects would be similar to those described under alternative 1. This alternative would result in impacts that are not substantially different from alternative 1. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect on invertebrates.

#### **IMPACTS OF ALTERNATIVE 4: EMPHASIZE UNDEVELOPED QUALITY AND NON-COMMERCIAL RECREATION**

**Black Bears:** In popular use areas for which visitor use would be slightly reduced, bears may have less frequent benign encounters with people, which may lead to a reduced frequency of habituation and food-conditioning relative to alternative 1. Because the reductions in visitor use would be slight, reductions in undesirable bear behavior as a result of this action would likely be slight as well. The removal of all existing designated campsites, assuming that this action results in a reduced concentration of visitor use, could result in a decrease in food-conditioning and resultant human/bear conflicts near these sites.

The beneficial effects would likely be offset by the removal of all food-storage boxes and the requirement for visitors to use portable food-storage containers. This could result in a net increase in food-conditioned behavior in bears if visitors do not properly store their food. The requirement for portable bear-resistant container use for all overnight users would not be expected to mitigate the loss of the food-storage boxes for the following reasons:

Many users on long backpacking trips (i.e., > 7 days) carry more food with them than will fit in portable containers (McCurdy and Martin 2007, Mazur 2008). Without food-storage boxes available to store food in until the volume is reduced to a level that will fit in the portable containers (e.g., during the first day or so of a trip), any improperly stored food would be available to bears.

An unknown percentage of users will refuse to carry portable containers, but would otherwise use food-storage boxes if they were available (McCurdy and Martin 2007, Mazur 2008). While such users could be violating regulations, the violations would occur nonetheless, and such improperly stored food would be available to bears.

Overall, two actions in this alternative could contribute to decreases in human/bear conflicts (reduced visitor use, removal of designated campsites), and one action could contribute to increases in human/bear conflicts (removal of all food-storage boxes) relative to alternative 1. It is likely that there would be a measurable increase in human/bear conflict rates from alternative 1.

**Cumulative Effects:** Cumulative effects would be similar to those described under alternative 1. The majority of other past, present, and future foreseeable projects in wilderness have little potential for effects on black bears. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under alternative 4 that would constitute a significant cumulative effect.

**Birds:** The closure of all meadows to grazing could contribute to reduced habitat quality for brown-headed cowbirds and could result in a decrease in parasitism to host species near these sites, relative to alternative 1. It is likely that there would be reduced stock use wilderness-wide under this alternative as a result of the closure of all meadows to grazing. This could result in reduced habitat quality for brown-headed cowbirds, and therefore, reductions in parasitism to host species near these sites. It is also possible that the complete replacement of stock grazing with the requirement that stock feed be carried into wilderness would have confounding effects. Increases in brown-headed cowbird abundance and parasitism rates could occur because it is likely that processed pellets and rolled grains that are not completely consumed by stock could be used as a supplemental food source by brown-headed cowbirds; however, this conclusion is speculative.

As with alternatives 2 and 3, because existing parasitism rates, based on the best available evidence, are thought to be unimportant in influencing native bird population dynamics in wilderness, impacts on native birds by these actions (adverse or beneficial) would likely be minimal. At the park-wide scale, decreases in stock-party sizes could potentially result in decreased habitat quality for brown-headed cowbirds, and therefore, decreases in parasitism to host species as well.

Impacts within the frontcountry would be similar to alternatives 2 and 3, as the relevant actions proposed are nearly identical, except for the modifications at the Atwell Mill Campground.

**Cumulative Effects:** Cumulative effects would be similar to those described under alternative 1. There are both adverse and beneficial effects as a result of ongoing and future potential actions outside the park, and internal park projects. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect on native birds.

## **Invertebrates**

*Trampling* – Trampling impacts would be similar to alternative 2, as the relevant actions proposed are nearly identical.

*Stock grazing* – Stock grazing impacts would be eliminated under this alternative, which would result in beneficial effects on invertebrates. Holmquist et al. (2010) found that within the parks' wilderness, at the beginning of the growing season and prior to stock arrival, there were few differences in invertebrate diversity and abundance between meadows with a long history of stock use and meadows with a long history of minimal use, therefore the beneficial effects would likely be minimal. Beneficial effects, if any, would likely be most pronounced in the closed meadows that previously experienced higher levels of grazing.

*Stock fording of streams* – Impacts on aquatic invertebrates downstream from fording sites would be similar to alternative 1. There would be no actions under alternative 4 that would measurably modify the frequency that streams would be forded by stock.

**Cumulative Effects:** Cumulative effects would be similar to those described under alternative 1. This alternative would result in impacts that are not measurably different from the status quo (alternative 1). Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect on invertebrates.

## IMPACTS OF ALTERNATIVE 5: EMPHASIZE OPPORTUNITIES FOR SOLITUDE

**Black Bears:** With wilderness visitor use levels notably reduced, bears may have fewer encounters with people, which may lead to a reduced frequency of habituation and food-conditioning relative to alternative 1. Because visitor use would be substantially reduced, decreases in undesirable bear behavior as a result of this action could be substantial as well. As with alternative 4, the removal of all existing designated campsites, assuming that this action results in a reduced concentration of visitor use, could also result in a decrease in food-conditioning and resultant human/bear conflicts near these sites.

The beneficial effects would likely be offset by the removal of all food-storage boxes and reliance on self-determined food-storage methods wilderness wide, resulting in a net increase in food-conditioned behavior in bears. Mazur (2008) found that 9% of backpacking parties surveyed in the parks used food hanging (a method historically overcome by bears in the parks) where portable container use was voluntary. While counterbalancing, or food-hanging, would not be a violation of park regulations, food stored in this manner would often become available to bears.

Overall, two actions in this alternative could contribute to decreases in human/bear conflicts (reduced visitor use; removal of designated campsites), and two actions could contribute to increases in human/bear conflicts (removal of all food-storage boxes; reliance on self-determined food-storage methods) relative to alternative 1. It is likely that there would be a measurable increase in human/bear conflicts from alternative 1.

**Cumulative Effects:** As described under alternative 1, the majority of other past, present, and future foreseeable projects in wilderness have little potential for effects on black bears. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under alternative 5 that would constitute a significant cumulative effect.

**Birds:** Alternative 5 could potentially reduce habitat quality and quantity for brown-headed cowbirds by reducing stock-party sizes, and reducing the number of meadows open to stock grazing. Additionally, frontcountry development of stock facilities would be limited to Cedar Grove, Wolverton, and South Fork. These actions could limit brown-headed cowbird abundance, and therefore, reduce parasitism on native bird species. However, the use of processed pellets or rolled grains as stock feed could provide a food source for brown-headed cowbirds and increase abundance slightly. Based on the rationale described previously, that brown-headed cowbird parasitism is unimportant in influencing native bird populations, beneficial effects on native bird populations from alternative 5 would likely be minimal.

**Cumulative Effects:** The projects that may affect brown-headed cowbirds, and therefore, affect native birds are described under alternative 1. There are both adverse and beneficial effects as a result of ongoing and future potential projects. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect on native birds.

### Invertebrates

*Trampling* – The substantial reduction of visitor use levels may reduce trampling impacts on invertebrates relative to alternative 1, but the difference would be slight because heavily trampled areas (e.g., maintained trails, campsites, etc.) would remain in that state regardless of the frequency of visitor use. Invertebrates in lightly trampled areas (e.g., informal trails) may experience additional benefits, but they would be slight.

*Stock grazing* – The closure of additional meadows to grazing could provide beneficial effects on invertebrates at these sites relative to alternative 1. In addition, there would be an elimination of grazing in areas closed to off-trail stock travel. However, as previously discussed, the beneficial effects would likely be minimal except in those areas that previously experienced higher levels of grazing.

*Stock fording of streams* – Impacts on aquatic invertebrates downstream from fording sites would be similar to alternative 1. There would be no actions under alternative 5 that would measurably modify the frequency that streams would be forded by stock.

**Cumulative Effects:** Cumulative effects would be similar to those described under alternative 1. This alternative would result in impacts that are not measurably different than the status quo. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect on invertebrates.

## CONCLUSION

**Black Bears:** Management under alternative 1 would result in adverse effects on bears; mitigation measures to avoid and minimize impacts, such as the placement and use of food-storage boxes, the use of portable bear-resistant containers, and visitor education, would be extensive. All action alternatives have the potential to modify habituation and food conditioning in bears; however, due to the removal of all food-storage boxes under alternatives 4 and 5, these alternatives could have a greater adverse impact on black bears if visitors do not store food properly. Alternatives 1, 2, and 3 would not have significant beneficial or adverse impacts on black bears in the parks.

**Birds:** Management under alternative 1 would result in long-term adverse impacts on bird species parasitized by brown-headed cowbirds, with impacts most pronounced in the frontcountry areas, but virtually absent throughout wilderness. Across all alternatives, modifications to grazing regulations, establishment or removal of stock camps, and modifications to frontcountry developments, may impact brown-headed cowbird populations and rates of parasitism to host species; but these impacts (adverse or beneficial) would likely be minimal because existing parasitism rates, based on the best available evidence, are thought to be unimportant in influencing native bird population dynamics in wilderness. Halterman et al. (1999), Verner and Ritter (1983) and Siegel and Wilkerson (2005) all concluded that brown-headed cowbirds were largely absent in natural areas of the Sierra Nevada and most of the parks' wilderness. Neither adverse nor beneficial significant impacts are anticipated from any of the plan alternatives on birds.

**Invertebrates:** Management under the no-action alternative would continue to result in long-term adverse impacts on invertebrates in heavily trampled areas (e.g., maintained trails, campsites, etc.). Additionally, there would be seasonal adverse impacts (for many species) and seasonal beneficial effects (for a few species) as a result of changes to stock grazing. Impacts on aquatic species from stock fording of streams would occur at a few fording sites that receive relatively heavy use; no measurable effects would be expected at the more numerous light to moderately used sites. Impacts on invertebrates would be measurable at a localized level and undetectable at the overall scale of wilderness. It is anticipated that invertebrate population dynamics would remain dominated by natural processes. Neither adverse nor beneficial significant impacts are anticipated from any of the plan alternatives on the invertebrate fauna.

## SPECIAL-STATUS SPECIES

This section provides an analysis of federally and state-listed threatened and endangered species, as well as candidate species, that are present within the Sequoia and Kings Canyon National Parks wilderness and

have the potential to be affected by components of the alternatives. The effects of the alternatives on critical habitat are also evaluated.

## **METHODOLOGY FOR ANALYZING IMPACTS**

Section 7 of the Endangered Species Act (ESA) mandates all federal agencies to determine how to use their existing authorities to further the purposes of the act to aid in recovering listed species, and to address existing and potential conservation issues. Section 7(a)(2) states that each federal agency shall, in consultation with the Secretary of the Interior, ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. *NPS Management Policies 2006* (NPS 2006) states that potential effects of agency actions should also be considered for state- or locally listed species. In this analysis, special-status species include wildlife that are federally or state listed, proposed, or candidates for listing (appendix L). Plant species of conservation concern are discussed under the “Vegetation” section.

Four federally listed or special-status species, the Yosemite toad, the Sierra Nevada yellow-legged frog, the northern distinct population segment of the mountain yellow-legged frog, and the Sierra Nevada bighorn sheep, have the potential to be affected by management actions within the WSP/DEIS alternatives. Within the boundaries of the parks, critical habitat has been designated for the bighorn sheep and proposed for the Yosemite toad, the Sierra Nevada yellow-legged frog and the northern distinct population segment of the mountain yellow-legged frog. Thus, the effect on critical habitat of these species is also analyzed.

This analysis was conducted using information obtained through best professional judgment of the parks’ staff, experts in the field, recovery plans and actions for listed species, ongoing data collection for other projects, and other supporting literature (as cited in the text). NPS observations and anecdotal evidence are included and described, when available. Impacts on special-status species were assessed in terms of changes in the amount and connectivity of special-status species habitat or critical habitat, integrity of the habitat (including past disturbance) and populations, and the potential for increased/decreased disturbance and number of individuals. The parks would adhere to additional measures required by a biological opinion issued by the USFWS (if applicable and in accordance with Section 7 of the ESA) beyond those described in this document. Mitigation measures and best management practices would be implemented to reduce, minimize, or eliminate the impacts on the parks’ natural resources (see the “Mitigation Common to All Alternatives” section of chapter 2).

## USFWS DETERMINATION OF IMPACTS

The following impact determinations, as defined by the USFWS, were used to characterize impacts on special-status species:

**No effect:** The effects of the proposed action and its interrelated and interdependent actions will not directly or indirectly affect special-status species or destroy/adversely modify designated or proposed critical habitat.

**May affect, not likely to adversely affect:** The effects of the proposed action and its interrelated and interdependent actions on special-status species, or designated or proposed critical habitat, are expected to be beneficial, discountable, or insignificant. Beneficial effects are contemporaneous positive effects without any adverse effects on the species or habitat. Insignificant effects relate to the size of the impact (and should never reach the scale where take occurs). Discountable effects are those that are extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur.

**May affect, likely to adversely affect:** The effects of the proposed action and its interrelated and interdependent actions on special-status species or designated critical or proposed habitat are expected to be adverse. In the event that the overall effect of the proposed action is beneficial to the listed species or critical habitat, but may also cause some adverse effect on individuals of the listed species or segments of the critical habitat, then the determination "is likely to adversely affect."

## YOSEMITE TOAD

The Yosemite toad is listed as a federally threatened species. Critical habitat is proposed within the northwest area of Kings Canyon National Park, including portions of the South Fork of the San Joaquin River and Middle Fork of the Kings River watersheds (USFWS 2013) (figure 25 on page 305). This is the only area of the parks where Yosemite toads are found.

**Types of Impacts on Yosemite Toad:** Visitor use, including its amount, concentration, timing, and mode of travel all influence the potential for adverse impacts on Yosemite toads. The impacts associated with the plan alternatives differ only slightly, although alternatives that support higher use levels, particularly stock use in Yosemite toad habitat, would be expected to have a slightly greater potential for adverse impacts on Yosemite toads.

In the context of the alternatives, there are three primary means by which Yosemite toads could be adversely affected, all of which are related to recreational activities: (1) disturbance during encounters with hikers and stock, (2) injury or mortality due to trampling by hikers and stock, and (3) degradation of habitat due to trails and/or stock use. There is some overlap between injury or mortality due to trampling, and potential degradation of habitat due to trampling.

*Disturbance* – Hiker and stock presence could cause Yosemite toads to move away and/or flee. Flight responses would be expected to be temporary in nature, and individuals that flee would typically be expected to resume their prior behaviors within a short amount of time. Therefore, this impact is discountable and insignificant.

*Injury and Mortality Due to Trampling* – Yosemite toads can suffer injury or death from trampling by hikers and stock. Although there is no documentation of Yosemite toads being trampled at the parks, it is



possible that it could occur. Also, in wet habitats, stock hoofprints can create deep impressions from which tadpoles cannot escape, leading to their death.

Some evidence suggests that adverse effects from increased interactions of Yosemite toads with people and/or stock would remain at a low level of biological significance: First, adult toads breed in standing water, typically in meadows, during early summer right after the snowpack melts. After one to two weeks of breeding, adults leave the water and migrate upslope for the rest of summer, foraging in mesic meadow habitat and using features such as rodent burrows for cover (Kagarise Sherman 1980, Kagarise Sherman and Morton 1984, Jennings and Hayes 1994). The early summer breeding window is when hiker/stock access is naturally limited due to lingering snow cover and wet ground conditions; thus potential effects from trampling and/or disturbance on breeding adult toads would be slight. Second, although adult toads are exposed for much of the summer in mesic meadow habitat, individuals are scattered, not congregated in large groups as when breeding. This helps reduce potential effects of trampling on the population. Third, foraging adults have access to cover habitat that may provide protection if they are deep enough to withstand caving under heavy loads. Toads in shallow burrows have occasionally been crushed by livestock (Jennings 1996, USFWS 2002). Fourth, toad eggs and tadpoles remain in water until shortly after metamorphosis, a period comprising approximately 6 to 10 weeks (Jennings and Hayes 1994, USFS et al. 2009) rather than 2 to 3 years as in mountain yellow-legged frogs. The comparatively short window when eggs and tadpoles are exposed reduces their overall vulnerability to trampling. In addition, Yosemite toad breeding involves large numbers of eggs/tadpoles, of which a small percentage are thought to survive to adulthood, meaning that mortality as a result of trampling is likely unimportant to Yosemite toad population dynamics. Finally, although there is potential for Yosemite toad individuals to be inadvertently trampled by people on foot, given the few locations where Yosemite toads are known to live near trails (3 out of approximately 15 populations in the parks, according to surveys conducted in 1997, 2001, 2002, 2004, and 2010–2013), trampling of Yosemite toads is expected to be rare. Therefore, while it is possible that individuals could be affected, it is highly unlikely that trampling would have a significant effect on Yosemite toad populations.

*Degradation of Habitat* – Actions associated with recreational use may have the greatest potential to impact Yosemite toad habitat in the parks. Foot and stock traffic within or adjacent to meadows can compact soil, displace vegetation, and increase erosion, particularly around streambanks. In extreme cases, soil compacted by high use traffic can cause lowered water tables, leading to a change in hydrology and ultimately in habitat for the Yosemite toad.

Human access to Yosemite toad habitat could also create impacts under each of the alternatives, though the severity from foot traffic would likely be less than that produced by stock. Stock can alter meadow habitat by removing vegetation during grazing. Grazing typically occurs in meadows, which is a primary toad habitat. Recreation of other types has overlap potential with all segments of toad habitat (NPS 2013d). Visitors are not confined to trails and could, therefore, access toad habitat in areas where stock would be restricted. Visitors generally camp close to water sources and could affect toad habitat by trampling, especially during repeated trips to water sources. Surveys from 1997 to 2012 have detected Yosemite toads in approximately 42 contiguous meadows in the parks. The populations of Yosemite toads are small and isolated, and therefore, adverse impacts on toad habitat could result in a measurable loss at the population level.

The effects of grazing plus recreation, in general, can be widespread, frequent, and persistent, and can be locally intense across the species range. Alteration of Yosemite toad habitat may result in changes in distribution and reduced abundance, potentially affecting populations. The parks contain relatively few Yosemite toad populations, and substantial adverse effects on even one population would make successful conservation more challenging. For example, one of the three populations near trails appears to currently be the largest Yosemite toad population in the parks. If effects on this population due to habitat

degradation are severe, it could make it substantially more challenging to conserve Yosemite toads in the parks. Therefore, the impacts on Yosemite toads across the alternatives are related to the amount of hiker and stock access and grazing that is allowed in Yosemite toad habitat.

### **IMPACTS OF ALTERNATIVE 1: NO-ACTION / STATUS QUO**

Under alternative 1, Yosemite toad populations near trails in the South Fork San Joaquin, Blue Canyon, and Evolution watersheds would continue to be occasionally disturbed during summer, resulting in flight response behavior due to encounters with hikers and stock. While individuals could be temporarily affected, there would be no effect on toad populations.

Encounters between Yosemite toads and hikers and/or stock have the potential to trample individual toads. Although individuals could be injured or die, given the few locations where Yosemite toads live near trails (including South Fork San Joaquin, Evolution, and the upper and lower Blue Canyon area) trampling events are expected to be rare. For example, the Yosemite toad population in the South Fork San Joaquin watershed appears to be stable over the past approximately 15 years, even though there is a trail nearby that brings people and stock in close proximity to toads on an annual basis. The small amount of potential trampling that may affect Yosemite toads under this alternative would be expected to result in no effect on their populations.

Degradation of toad habitat due to trails and/or stock grazing has the potential to adversely affect Yosemite toad habitat. There are few locations where Yosemite toad populations are known to inhabit areas near trails; therefore, the overall potential for degradation under this alternative from foot and stock traffic would be small. Grazing in Yosemite toad habitat would continue in limited locations in Kings Canyon National Park, such as in the upper and lower Blue Canyon area. As stated previously, grazing can alter Yosemite toad habitat and affect individual toads by trampling. Due to the small number and size of Yosemite toad populations in the parks, if the effects on any of the populations due to habitat degradation are severe, it would be substantially more challenging to conserve Yosemite toads in the parks. However, under this alternative, stock use and grazing would continue to be managed to prevent severe habitat degradation; therefore, there may be adverse impacts on individual toads, but the potential for population-wide effects is small.

**Cumulative Effects:** Other than those ongoing projects and activities associated with the administration of wilderness (i.e., facility and visitor-use management), there are few past, present, or future foreseeable projects in the parks' wilderness that have a detectable effect on Yosemite toad.

The projects that may affect Yosemite toads that are separate from projects proposed by this WSP/DEIS include activities related to Yosemite toad, the aquatics restoration plan, and permitted research projects. Several past and ongoing activities include observation and analysis of data collected. These would not directly impact Yosemite toads, but would provide information for management of the species and related visitor activities. Two additional studies require direct handling of toads to collect genetic information and skin swabs for analysis of the effects of chytrid fungus. This would impact the toads temporarily, but would not create a measurable impact on their populations. The aquatics restoration plan is working to remove nonnative fish from waterbodies within the parks. This project could have short- to long-term adverse impacts on two Yosemite toad populations during removal actions, depending on methods used to remove the fish. Over the long-term, this project will have a beneficial effect on Yosemite toads, as it removes one threat to the species. Permitted research activities throughout wilderness cover a variety of resources, including herpetology (one of the most frequent topics for research in wilderness in the past three years in the parks) and sensitive species. Research projects may temporarily disturb Yosemite toads, depending on methods used to track and to collect data, but overall, the knowledge gained would be beneficial and could be applied to wildlife management plans.

Since alternative 1 proposed no changes to the management of Yosemite toads in wilderness, there would be no significant cumulative impacts associated with the alternative.

### **Impacts of Alternative 2: Protect Wilderness Character by Implementing Site-specific Actions (NPS Preferred Alternative)**

There would be reduced potential for visitors to interact with Yosemite toads and alter toad habitat under alternative 2. Several unmaintained trails in the South Fork San Joaquin, Evolution and Blue Canyon areas would be converted to maintained trails, which could reroute the trail further away from toad breeding habitat. In addition, a smaller party-size restriction would be implemented for stock groups in the upper South Fork San Joaquin area. Alternative 2 would impose additional restrictions in Yosemite Toad habitat that would reduce the potential for direct impacts to toads and indirect effects due to habitat modification. Grazing would be prohibited in the upper and lower Blue Canyon area. Stock parties would be limited to day-use in Upper Blue Canyon. Stock travel in day-use only areas (Upper South Fork San Joaquin, Lake 11,106 feet, and Upper Blue Canyon) would be limited to within 100 yards of trails. Stock party size in Upper South Fork San Joaquin would be limited to no more than 12 stock. All stock travel would be prohibited on the unmaintained trail in McGee Canyon. This would reduce the potential for disturbance and trampling of Yosemite toads, which could result in beneficial effects on toads and their habitat in the South Fork San Joaquin, Evolution, and Blue Canyon areas.

There would still be grazing allowed in some meadows within the South Fork San Joaquin and Evolution areas, but new limitations on the amount of grazing allowed would provide greater habitat protection. Yosemite toads would continue to benefit from the limitation which allows grazing only for walking parties with burros and llamas from Evolution Lake to Muir Pass. As stated under alternative 1, the Yosemite toad population in the upper South Fork San Joaquin appears to be stable; stock use and grazing under alternative 2 would be expected to result in a minimal overall adverse effect on Yosemite toad populations at the scale of the parks.

**Cumulative Effects:** Other than those ongoing projects and activities associated with the administration of wilderness (i.e., facility and visitor-use management), there are few past, present, or future foreseeable projects in the parks' wilderness that have a detectable effect on Yosemite toads. The impacts would be the same as described for alternative 1. This alternative would result in impacts that are slightly less than the no-action alternative (alternative 1). Further restrictions for access by stock, and grazing closures, could result in beneficial effects on Yosemite toads. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

### **Impacts of Alternative 3: Provide More Opportunities for Primitive Recreation**

Under alternative 3, there would be increased opportunities for visitors to interact with Yosemite toads and to recreate in toad habitat. Visitor use levels would be allowed to increase, including in popular areas near toad populations. Several unmaintained trails in the South Fork San Joaquin, Evolution and Blue Canyon areas would be converted to maintained trails, which could reroute the trail further away from toad breeding habitat. There would be no additional party-size restrictions implemented for stock groups in the upper South Fork San Joaquin area.

Alternative 3 would allow greater numbers of stock for day and on-trail use, which could lead to a greater chance of trampling and habitat degradation in areas where stock are permitted. However, as with all alternatives, there are a limited number of sites at which Yosemite toads are known to overlap with hiker and/or stock use, so the adverse effects would be expected to be minimal. In addition, the seven-night consecutive limit at any one place proposed under this alternative would reduce the amount of time a

group of visitors would be allowed to camp at one location in wilderness. Visitors tend to camp near water sources; allowing longer stays in a single campsite generally results in greater impacts due to the tendency of people to spread into larger areas and create informal trails. By reducing the consecutive-night stay under alternative 3, potential impacts on Yosemite toad habitat from longer stays would be reduced.

Alternative 3 would impose additional restrictions in Yosemite Toad habitat that would reduce the potential for direct impacts to toads and indirect effects due to habitat modification. Grazing would be prohibited in the upper and lower Blue Canyon areas. Stock parties would be limited to day-use in Upper Blue Canyon. Stock travel in day-use only areas (Upper South Fork San Joaquin, Lake 11,106 feet, and Upper Blue Canyon) would be limited to within 100 yards of trails. All stock travel would be prohibited in McGee Canyon. There would still be grazing allowed in some meadows within the South Fork San Joaquin and Evolution areas, but new limitations on the amount of grazing allowed would provide greater habitat protection. Yosemite toads would continue to benefit from the limitation which allows grazing only for walking parties with burros and llamas from Evolution Lake to Muir Pass. As stated under alternative 1, the Yosemite toad population in the upper South Fork San Joaquin appears to be stable; so continuing the current grazing management program would be expected to result in a minimal overall adverse effect on Yosemite toad populations at the scale of the parks.

**Cumulative Effects:** Other than those ongoing projects and activities associated with the administration of wilderness (i.e., facility and visitor-use management), there are few past, present, or future foreseeable projects in the parks' wilderness that have a detectable effect on Yosemite toads. The impacts from these projects are the same as described for alternative 1. This alternative would result in little change from current conditions. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

#### **Impacts of Alternative 4: Emphasize Undeveloped Quality and Non Commercial Recreation**

There would be reduced potential for visitors to interact with Yosemite toads and alter habitat under alternative 4. Several unmaintained trails in the South Fork San Joaquin, Evolution and Blue Canyon areas would be converted to maintained trails, which could reroute the trail further away from toad breeding habitat. Alternative 4 would also decrease visitor use slightly, and limit where stock travel is allowed on- and off-trail, decreasing impacts from potential trampling and habitat degradation. Under this alternative, the entire Upper South Fork San Joaquin and Hell-for-Sure Trails (approximately 11.6 miles of trail) would be closed to commercial stock use. No stock would be allowed above Franklin-Montgomery Meadow (approximately 9.7 miles of the trail). Additionally, the entire Blue Canyon Trail would be abandoned and therefore closed to stock access. These actions would reduce the potential for stock to impact toads and toad habitat in these areas.

Alternative 4 would prohibit grazing wilderness-wide, eliminating the potential for future impacts from habitat degradation related to vegetation removal and trampling from stock grazing. Under alternative 4, Yosemite toads would continue to be periodically exposed to the potential for trampling and/or disturbance from hikers and stock as described for the other alternatives. However, these impacts would be less than those under the no-action alternative (alternative 1). In addition, these effects would be minimal and would be expected to have little overall adverse effect on Yosemite toad populations at the scale of the parks.

**Cumulative Effects:** As described under alternative 1, there are few past, present, or future foreseeable projects that would result in a detectable effect on Yosemite toads. The establishment of additional

protective measures for meadows in Yosemite toad habitat would benefit individual toads but is not likely to have an effect on toad populations at the scale of the parks. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

### **Impacts of Alternative 5: Emphasize Opportunities for Solitude**

There would be reduced potential for visitors to interact with Yosemite toads and alter toad habitat under alternative 5, primarily from the overall reduction in visitor use levels wilderness wide. Several unmaintained trails in the South Fork San Joaquin, Evolution and Blue Canyon areas would be converted to maintained trails, which could reroute the trail further away from toad breeding habitat. Alternative 5 would impose additional restrictions in Yosemite Toad habitat that would reduce the potential for direct impacts to toads and indirect effects due to habitat modification. Grazing would be prohibited in the upper and lower Blue Canyon areas. Stock parties would be limited to day-use in Upper Blue Canyon. Stock travel in day-use only areas (Upper South Fork San Joaquin, Lake 11,106 feet, and Upper Blue Canyon) would be limited to within 100 yards of trails. Stock party size in Upper South Fork San Joaquin would be limited to no more than 12 stock. All stock travel would be prohibited in McGee Canyon. There would still be grazing allowed in some meadows within the South Fork San Joaquin and Evolution areas, but new limitations on the amount of grazing allowed would provide greater habitat protection. Yosemite toads would continue to benefit from the limitation which allows grazing only for walking parties with burros and llamas from Evolution Lake to Muir Pass. While grazing activities in toad habitat still could result in adverse effects on individual toads and their habitat, the toad population in the upper South Fork San Joaquin appears to be stable. This alternative would result in impacts that are less than those under the no-action alternative (alternative 1). Adverse effects under this alternative would likely be minimal and would be expected to have little overall adverse effect on Yosemite toad populations at the scale of the parks.

**Cumulative Effects:** The projects that may affect Yosemite toads that are separate from projects proposed by this WSP/DEIS include Yosemite toad activities, the aquatics restoration plan, and permitted research projects as described under alternative 1. The majority of other past, present, and future foreseeable projects in wilderness have little potential for measurable effects on Yosemite toads. This alternative would result in reduced visitor use in the wilderness, but little change to Yosemite toads or their habitat from current conditions. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

### **MOUNTAIN YELLOW-LEGGED FROGS**

This section evaluates impacts on mountain yellow-legged frogs that may result from implementation of the alternatives. Mountain yellow-legged frogs are a native amphibian species complex within the parks that includes two species: the Sierra Nevada yellow-legged frog (found within the South Fork San Joaquin and Middle Fork Kings River watersheds in the parks) and the northern distinct population segment (DPS) of the mountain yellow legged-frog, which inhabits the South Fork Kings River and Kern River watersheds (Vredenburg et al. 2007) (figure 25 on page 305).

**Types of Impacts on Mountain Yellow-legged Frogs:** In the context of the alternatives, there are three primary means by which mountain yellow-legged frogs could be adversely affected, all of which are related to recreational activities: disturbance during encounters with hikers and stock, injury or mortality due to trampling by hikers and stock, and degradation of habitat due to trails and/or stock use. The amount of visitor use, its concentration, its timing, and the visitor's mode of travel all influence the potential for adverse impacts on mountain yellow-legged frogs. However, the potential for impacts from visitor use can be reduced or eliminated through the appropriate trail design, education and monitoring

efforts, discussed in “Mitigation Common to All Alternatives” section. For this reason, the impacts associated with the plan alternatives differ only slightly, although alternatives that support higher use levels, particularly stock use, would be expected to have a greater potential for impacts on mountain yellow-legged frogs.

*Disturbance* – Hiker and stock presence in mountain yellow-legged frog habitat could result in disturbance. Adverse impacts on the frogs would include movement away from the disturbance and/or flight responses (i.e., temporary displacement). Flight responses would be expected to be temporary in nature, and individuals that flee would typically be expected to resume their prior behaviors within a short amount of time. Therefore, this impact is discountable and insignificant.

*Injury and Mortality due to Trampling* – Recreation activities and administrative activities may threaten all life stages of the frogs through direct disturbance resulting from trampling. Use of stock adds to the effects of trampling, which can cause direct mortality to mountain yellow-legged frogs. The frogs use a variety of aquatic habitats, and are known to lay eggs in shallow areas where humans and stock could step on them. At the parks, mountain yellow-legged frog deaths from trampling have been recorded in a meadow in Sixty Lake Basin (USFS et al. 2009). Although individuals could be injured or perish, given the relatively few locations where mountain yellow-legged frogs inhabit areas near trails (seven out of a few dozen populations in the parks), trampling events on mountain yellow-legged frogs are expected to be rare.

Mountain yellow-legged frogs have behaviors that could both mitigate and contribute to the potential for adverse effects from increased interactions of hikers and/or stock. Behaviors that mitigate exposure include the following. Adult mountain yellow-legged frogs breed in standing water during early summer right after the snowpack melts (Stebbins and McGinnis 2012). The early summer breeding window is when hiker/stock access is naturally limited due to lingering snow cover and wet ground conditions, and thus potential effects from trampling and/or disturbance on egg masses would be minimal. Second, mountain yellow-legged frogs employ a breeding strategy common among amphibians in which large numbers of eggs/tadpoles are produced, of which a small percentage survive to metamorphosis and then to adulthood (Pough et al. 2001). Injury or mortality to tadpoles or recently metamorphosed frogs would therefore be a similar fate as the majority of juvenile animals in the population. Third, adult mountain yellow-legged frogs do not leave the water after breeding since they are highly aquatic throughout the year (Stebbins and McGinnis 2012); however, they often migrate away from breeding waters and forage at separate nearby waters (Lannoo 2005). Frogs on shorelines or in shallow water zones would therefore be at risk of being trampled, but they can escape to protective aspects of deep water if they move quickly.

In contrast, there are frog behaviors that contribute to exposure and potential impacts. First, mountain yellow-legged frogs often congregate in large groups during the day, including tadpoles in warm, shallow water and basking frogs on emergent shoreline vegetation, rocks, and logs (Rachowicz and Vredenburg 2004). Second, after mountain yellow-legged frog eggs hatch during mid-summer, tadpoles remain in the water for 2 to 3 years, until metamorphosis is achieved (Lannoo 2005). The long window of tadpole exposure increases their overall vulnerability to trampling.

The potential for injury or mortality to mountain yellow-legged frog individuals from trampling exists. However, given the relatively small number of mountain yellow-legged frog populations near trails and the behaviors that may mitigate the potential for adverse effects, effects from trampling are unlikely to result in substantial adverse effects at the population level. For example, the mountain yellow-legged frog population in the upper Evolution watershed appears to be stable over the past approximately 15 years, even though there is a high-use trail nearby that brings numerous hikers and stock in close proximity to mountain yellow-legged frogs on an annual basis. Therefore, while it is possible that individual frogs could be affected, it is highly unlikely that trampling would have an adverse effect on frog populations.

*Degradation of Habitat* – Visitors and stock can affect mountain yellow-legged frog habitat from direct use of their habitat or use of trails adjacent to streams and meadows. Through grazing and trampling, stock can alter habitats by removal of vegetation, soil compaction, erosion, and sloughing of streambanks. Degradation of mountain yellow-legged frog habitat due to trails and/or stock use has the potential to adversely affect mountain yellow-legged frog populations. Trails get used by foot and stock traffic that can compact soil, displace vegetation, and increase erosion. When trails are located in or near meadows, soil compaction can result and this type of habitat alteration has the potential to eventually lower the water table (Kondolf et al. 1996). Four of the seven populations near trails are currently among the largest populations in the parks. If effects on these populations due to habitat degradation are severe, it could make it more challenging to conserve mountain yellow-legged frogs in the parks. When meadows degraded by trails are occupied by mountain yellow-legged frogs, the altered hydrology may result in reductions in distribution and abundance (USFWS 2013). If the loss of water is severe enough, effects originally derived from trails could indirectly result in the loss of mountain yellow-legged frog populations.

### **Impacts of Alternative 1: No-action / Status Quo**

Under alternative 1, mountain yellow-legged frog populations immediately adjacent or close to trails in the upper Funston, Bubbs, South Fork Woods, Dusy, Middle Fork Kings, and Evolution watersheds would continue to be occasionally disturbed during encounters with hikers and stock during the summer months. Adverse impacts would include movement away from the disturbance, and/or flight responses (i.e., temporary displacement). Flight responses would be expected to be temporary in nature, and individuals that flee would typically be expected to resume their prior behaviors within a short amount of time.

As discussed, there could be individual frogs affected from trampling by hikers and stock. Given the relatively small number of mountain yellow-legged frog populations near trails and the behaviors that may mitigate the potential for adverse effects, effects from trampling may affect some individual frogs, but are unlikely to result in adverse effects at the population level.

Degradation of mountain yellow-legged frog habitat due to trails and/or stock use has the potential to adversely affect mountain yellow-legged frogs. Seven populations of mountain yellow-legged frogs are located near trails where the greatest impacts from recreation activities occur; therefore, the potential for overall habitat degradation would be expected to be slight. Given the few locations where mountain yellow-legged frog populations inhabit areas near trails, the overall potential for habitat degradation under this alternative would be expected to be small.

**Cumulative Effects:** Other than those ongoing projects and activities associated with the administration of wilderness (i.e., facility and visitor-use management), there are few past, present, or future foreseeable projects in the parks' wilderness that have a detectable effect on mountain yellow-legged frog or their habitat.

The projects that may affect mountain yellow-legged frogs that are separate from projects proposed by this WSP/DEIS include the aquatics restoration plan, related studies on frogs, and permitted research projects. The aquatics restoration plan is working to remove nonnative fish from selected high-elevation waterbodies within the parks. This project could have short- to long-term adverse impacts on mountain yellow-legged frogs during removal actions, depending on the methods used to remove the fish. Over the long-term, this project will have a beneficial effect on mountain yellow-legged frogs, as it removes one of the largest threats to the species. Studies on frogs include invasive actions such as marking animals for tracking purposes, removal of individuals for disease studies, and treating individuals with antifungal cleansers and probiotics. These actions are adverse in the short-term, as members of the population could

be removed; however, the research could result in information that could help conservation of the species. Additionally, other frog studies involve reintroduction attempts on NPS and USFS lands. Where the attempts were successful, these actions produced beneficial effects on mountain yellow-legged frogs. Permitted research activities throughout wilderness cover a variety of resources including herpetology, one of the most frequent topics for research in wilderness in the past three years in the parks, and sensitive species. Research projects may temporarily disturb mountain yellow-legged frogs, depending on the methods of tracking and collecting data, but overall, the knowledge gained would be beneficial and could be applied to wildlife management plans.

Since alternative 1 proposed no changes to the management of mountain yellow-legged frogs in wilderness, there would be no significant cumulative impacts associated with the alternative.

### **Impacts of Alternative 2: Protect Wilderness Character by Implementing Site-specific Actions (NPS Preferred Alternative)**

The potential for hikers and stock to interact with mountain yellow-legged frogs would remain similar to those described under alternative 1. Slight beneficial effects on mountain yellow-legged frogs and/or frog habitat could occur under alternative 2 due to the elimination of stock travel or restriction of stock travel to within 100 yards of the trail in 10 areas, as well as the elimination of grazing in 4 areas. In areas that remain open to grazing, implementation of additional controls on grazing could also provide slight benefits. The potential for injury or mortality to mountain yellow-legged frog individuals from trampling exists under alternative 2; however, effects from trampling are unlikely to result in impacts at the population level.

**Cumulative Effects:** Other than those ongoing projects and activities associated with the administration of wilderness (i.e., facility and visitor-use management), there are few past, present, or future foreseeable projects in the parks' wilderness that would have a detectable effect on mountain yellow-legged frogs. The impacts from these projects are described for alternative 1. This alternative would result in impacts that are not substantially different from alternative 1 with some localized beneficial effects in areas closed to stock or grazing. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

### **Impacts of Alternative 3: Provide More Opportunities for Primitive Recreation**

There would be increased potential for hikers and stock to interact with mountain yellow-legged frogs under alternative 3, especially if increased visitor use occurs near frog populations. Alternative 3 would allow greater numbers of stock on-trail use, which could lead to an increased chance of trampling and habitat degradation in areas where stock are permitted. However, there would be a relatively small number of sites at which mountain yellow-legged frogs would overlap with hikers and/or stock. Slight beneficial effects on mountain yellow-legged frogs and/or frog habitat could occur under alternative 3 due to the elimination of stock travel or restriction of stock travel to within 100 yards of the trail in 6 areas, as well as the elimination of grazing in 3 areas. In areas that remain open to grazing, implementation of additional controls on grazing could also provide slight benefits.

Under alternative 3, the consecutive night stay would be limited to 7 days, half of that allowed under alternatives 1 and 2. Visitors tend to camp near water sources, and allowing longer stays in a single campsite generally would result in increased impacts due to the tendency of people to spread into larger areas. By reducing the consecutive night stay under alternative 3, potential impacts on mountain yellow-legged frog habitat that tends to occur with longer stays would be reduced.



Similar to alternative 2, injury or mortality to individuals from trampling would be unlikely to result in adverse effects at the population level under this alternative; however, periodic threats from trampling and/or disturbance from hikers and stock would continue to be possible.

**Cumulative Effects:** The projects that may affect mountain yellow-legged frogs that are separate from projects proposed by this WSP/DEIS include the aquatics restoration plan, related studies on frogs, and permitted research projects. The majority of other past, present, and future foreseeable projects in wilderness have no potential for measurable effects on mountain yellow-legged frogs. The impacts from these projects are described under alternative 1. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

### **Impacts of Alternative 4: Emphasize Undeveloped Quality and Non Commercial Recreation**

Alternative 4 would be the most protective of resources in that no grazing would be permitted wilderness-wide, reducing potential impacts from habitat degradation related to vegetation removal from stock grazing. Under this alternative, restrictions on off-trail travel by stock would also lead to increased habitat protection. Disturbance from hikers and stock as described for the other alternatives could occur under alternative 4. However, mountain yellow-legged frogs could experience slightly increased beneficial effects from reduced trailhead quotas, further restricted stock use in mountain yellow-legged frog habitat (primarily restrictions regarding commercial stock), and the elimination of stock grazing.

**Cumulative Effects:** The projects that may affect mountain yellow-legged frogs that are separate from projects proposed by this WSP/DEIS include the aquatics restoration plan, related studies on frogs, and permitted research projects. The majority of other past, present, and future foreseeable projects in wilderness have no potential for measurable effects on mountain yellow-legged frogs. The impacts from these projects are described under alternative 1. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

### **Impacts of Alternative 5: Emphasize Opportunities for Solitude**

Slight beneficial effects on mountain yellow-legged frogs and/or frog habitat could occur under alternative 5 due to the elimination of stock travel or restriction of stock travel to within 100 yards of the trail in 10 areas, as well as the elimination of grazing in 2 areas. In areas that remain open to grazing, implementation of additional controls on grazing could also provide slight benefits. Even with the protective measures in place, mountain yellow-legged frogs would be periodically exposed to trampling impacts and/or disturbance from hikers and stock as described for the other alternatives.

**Cumulative Effects:** The projects that may affect mountain yellow-legged frogs that are separate from projects proposed by this WSP/DEIS include the aquatics restoration plan, related studies on frogs, and permitted research projects. The majority of other past, present, and future foreseeable projects in wilderness have no potential for measurable effects on mountain yellow-legged frogs. The impacts from these projects are described for alternative 1. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

## **SIERRA NEVADA BIGHORN SHEEP**

This section evaluates impacts on Sierra Nevada bighorn sheep (bighorn sheep) and designated critical habitat that may result from implementation of the WSP/DEIS alternatives. The bighorn sheep is listed as

a federal and state endangered species. In Sequoia and Kings Canyon National Parks, bighorn sheep primarily occur along the eastern boundaries within wilderness in alpine and subalpine habitats. There are 93,174 acres of designated critical habitat for the bighorn sheep located within the parks, which represents 22% of the total for this species. The USFWS (2007) divided potential bighorn sheep habitat into 16 herd units in the *Recovery Plan*, 10 of which are located wholly or partially within the parks. Of these 16 herd units, 12 have been identified as essential to recovery of the species because of habitat characteristics that make them the most likely areas where recovery will occur. Eight of the 12 essential herd units are located wholly or partially within the parks: Wheeler Ridge, Taboose Creek, Sawmill Canyon, Mount Baxter, Mount Langley, Mount Williamson, Big Arroyo, and Laurel Creek (figure 26 on page 308). Ten ewes and four rams were reintroduced into the Big Arroyo herd unit in March 2014, which was previously vacant. The Laurel Creek herd unit currently does not contain bighorn sheep but future reintroductions are planned (NPS 2011b).

**Types of Impacts on Sierra Nevada Bighorn Sheep:** In the context of the alternatives, there are two primary means by which bighorn sheep could be adversely impacted, both of which are related to recreational activities: disturbance during encounters with hikers, backpackers, stock and interactions with stock at foraging sites. The amount of recreational and administrative use, its concentration, its timing, and the mode of travel all influence the potential for adverse impacts on bighorn sheep. However, the potential for impacts from visitor use can be reduced or eliminated through the appropriate design, education and monitoring efforts, discussed in detail in the “Mitigation Common to All Alternatives” section of chapter 2. For this reason, the impacts associated with the plan alternatives differ only slightly, although alternatives that support higher use levels, particularly higher levels of stock use, would be expected to have a slightly greater potential for impacts on bighorn sheep.

*Disturbance* – Adverse impacts on bighorn sheep would include movement away from the disturbance (i.e., temporary displacement) and likely stress-related responses such as elevated heart rates (MacArthur et al. 1979, MacArthur et al. 1982) or increased vigilance, resulting in reduced foraging efficiency (Pelletier 2006). Stress had been documented to cause compromised immune systems in some bighorn populations (Spraker et al. 1984), but it is unlikely that stress-related disease would occur in bighorn sheep because it has not been documented previously during routine disease testing of radio-collared animals [Sierra Nevada Bighorn Sheep Recovery Program (2004)].

There are two lines of evidence that suggest adverse impacts of increased bighorn sheep / human interactions would continue to remain below the level of biological significance. First, bighorn sheep have habituated to human activity in many places (Stanger et al. 1986, Papouchis et al. 2001, Jansen et al. 2007), including within the parks. Two studies from the 1970s that took place at Mount Baxter (when visitor-use levels were approximately double what they are today) indicate that bighorn sheep activity patterns were influenced by frequent encounters with visitors but no permanent displacement occurred (Wehausen et al. 1977), and that bighorn sheep became conditioned to hikers and continued to return to their habitat despite repeated encounters with visitors (Hicks and Elder 1979). There is no evidence that the situation at Mount Baxter has changed since the 1970s, and it appears to exist in other herds. For example, bighorn sheep in the Mount Langley herd tolerate people at close distances in the Upper Soldier Lake area. It appears likely that, as long as disturbance is predictable and non-threatening, bighorn sheep can adapt to human activity (Papouchis et al. 2001).

Second, Hicks and Elder (1979) found that because people preferred to camp near water and trails and bighorn sheep preferred to inhabit areas where these features do not exist, there was limited opportunity for human/bighorn sheep interactions around Mount Baxter. Presumably, this situation continues to exist throughout bighorn sheep habitat in the parks and as long as it does, increased human activity is likely to have little impact on bighorn sheep because there will still remain substantial spatial segregation.

*Stock Interaction* – There appear to be few adverse impacts on bighorn due to stock interactions and this would be expected to continue. Disease transmission between stock and bighorn sheep would be unlikely because experimental studies indicate that llamas and horses (these two species, along with burros and mules, are the only animals allowed for use as stock in the parks) can be safely co-pastured with bighorn sheep without incident (Foreyt and Lagerquist 1996). There are a variety of other potential impacts that include bighorn sheep avoidance of important habitat (i.e., meadows) in which stock occur (Ostermann et al. 2008); increased vigilance and reduced foraging efficiency in the presence of stock (Brown et al. 2010); stock trampling of meadow vegetation important to bighorn sheep (Cole and Spildie 1998); and, competition between stock and bighorn sheep for forage (Krausman et al. 1999). If such adverse impacts occur, based on the indicators described below, there is no evidence to suggest that they would occur at a level of biological significance.

In 2007, the *Recovery Plan for the Sierra Nevada Bighorn Sheep* stated “there is no evidence that commercial, recreational, scientific, or educational activities currently are significant threats” and “...at present there appear to be few locations where recreational disturbance has the potential to significantly affect bighorn sheep” (USFWS 2007). In addition, the following indicators are inconsistent with hypotheses regarding substantial adverse impacts from disturbance or interactions with stock at foraging sites.

Since 1999 there has been substantial population growth in the four herds using the parks that are annually monitored (Wheeler Ridge, Sawmill, Mount Baxter, and Mount Langley) (Stephenson et al. 2012). In recent years, growth has slowed or even declined in these herds, apparently due to emigration to vacant habitats or density-dependent mechanisms (i.e., herds may be approaching carrying capacity) (Stephenson et al. 2012). However, these are natural phenomenon and not likely related to park management.

Body condition data for the Wheeler Ridge and Mount Langley herds (the only herds for which data are available) suggest that adult ewes are not nutritionally limited (Stephenson et al. 2012).

There is no evidence that bighorn sheep have abandoned suitable habitat. To the contrary, within the last decade, natural range expansions have occurred into previously unoccupied areas. The Bubbs Creek herd was founded (likely from individuals dispersing from Mount Baxter herd), the Taboose Creek herd unit has been explored by an unknown number of individual ewes from the Sawmill Canyon herd, and the Convict Creek herd unit has recently been colonized by both ewes and rams, likely from the Wheeler Ridge herd (Stephenson et al. 2012).

Disease prevalence in the parks is quite low in bighorn sheep, especially compared to populations elsewhere (Sierra Nevada Bighorn Sheep Recovery Program 2004).

Evidence from ongoing research examining bighorn-stock interactions indicates that (1) there is little overlap in space use of meadows used by bighorn sheep and stock (i.e., most meadows open to stock grazing are not within bighorn sheep habitat) and (2) vegetation structure and species composition in meadows does not vary between meadows used by stock only, bighorn sheep only, both species, or neither species in a direction that suggests a significant negative impact to bighorn habitat from stock grazing (California Department of Fish and Game, unpublished data).

### **Impacts of Alternative 1: No-action / Status Quo**

Under alternative 1, bighorn sheep in the Wheeler Ridge, Sawmill, Mount Baxter, and Mount Langley herds would continue to be occasionally disturbed during encounters with hikers and stock during the summer months, which is when the bighorn sheep generally occupy the parks (the Bubbs Creek herd

inhabits the parks year-round and the newly created Big Arroyo herd is anticipated to as well). There appears to be few adverse impacts on bighorn sheep from hikers and stock use (as described above) under current conditions; therefore, these disturbances would be of no biological importance.

**Cumulative Effects:** Other than those ongoing projects and activities associated with the administration of wilderness (i.e., facility and visitor-use management), there are few past, present, or future foreseeable projects in the parks' wilderness that have a detectable effect on bighorn sheep.

Past, present, and reasonably foreseeable actions occurring within the parks and the surrounding area that would be expected to contribute to cumulative impacts on bighorn sheep include recovery and reintroduction activities. These activities are conducted by the California Department of Fish and Wildlife, both within the parks and adjacent to them, and have been ongoing since 1999 when the species was first listed under the ESA. Activities include capturing and monitoring sheep, reintroductions to formerly occupied habitats, translocations between herd units, and predator management. These activities would have short-term adverse effects and long-term beneficial effects on Sierra Nevada bighorn sheep. Since alternative 1 proposed no changes to the management of bighorn sheep in wilderness, there would be no significant cumulative impacts associated with the alternative.

### **Impacts of Alternative 2: Protect Wilderness Character by Implementing Site-specific Actions (NPS Preferred Alternative)**

There could be an increased frequency of bighorn sheep / human encounters under alternative 2 if new Class 1 trails are established in bighorn sheep habitat. However, new Class 1 trails, such as one proposed to replace the numerous social trails on Mount Langley, could actually concentrate use which would benefit bighorn sheep by making human activity more predictable. Also, as the social trails are restored, habitat would be restored in this area, resulting in beneficial effects on bighorn habitat.

Interactions could decrease if visitor use levels are reduced in the most popular areas (e.g., Mount Whitney Management Area). Smaller stock- party sizes could decrease the severity of bighorn sheep stress-related responses during interactions. Bighorn sheep could benefit (from the perspective of forage competition with stock) from prohibiting stock in portions of the Rae Lakes and Dusy Basin watersheds, and with additional meadows closed to stock grazing under this alternative. These beneficial effects are anticipated to be minimal.

There could be disturbance impacts on bighorn sheep during the relocation of the Bench Lake tent platform, but these would be localized and temporary. Site selection would consider bighorn habitat and use patterns to limit the modification of habitat and reduce long-term effects associated with disturbance.

**Cumulative Effects:** Other than those ongoing projects and activities associated with the administration of wilderness (i.e., facility and visitor-use management), there are few past, present, or future foreseeable projects in the parks' wilderness that have a detectable effect on bighorn sheep. The projects that may affect bighorn sheep that are separate from projects proposed by this WSP/DEIS include research and recovery actions previously described under alternative 1.

The cumulative effects would be similar to those described under alternative 1. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

### **Impacts of Alternative 3: Provide More Opportunities for Primitive Recreation**

Under alternative 3, visitor use levels could increase on trails that intersect bighorn sheep habitat and new Class 1 trails could be established in bighorn sheep habitat; these actions could result in an increase in

bighorn sheep / human encounters. However, establishing Class 1 trails could also result in beneficial effects on bighorn sheep as described under alternative 2. Alternative 3 would allow for a greater number of stock per party, potentially increasing stress-related responses in bighorn sheep. It is unclear how higher contact rates would impact bighorn relative to current conditions because while there is certainly a threshold level at which disturbance becomes adverse at a biologically significant level (e.g., reproduction or survival declines due to reduced foraging efficiency), tolerance levels and dependable criteria have not been established (Krausman et al. 1999). For the reasons described above under “Types of Impacts on Sierra Nevada Bighorn Sheep,” it is probable that the impacts related to increased bighorn-human interactions would continue to remain below the level of biological significance.

The restriction on grazing in off-trail areas would benefit newly reintroduced bighorn sheep in portions of the Big Arroyo herd unit, and in portions of the Laurel Creek herd unit, if bighorn sheep are eventually reintroduced there. Bighorn sheep could also benefit (from the perspective of forage competition with stock) from the disallowance of stock in portions of the Rae Lakes watershed, and with additional meadows closed to stock grazing under this alternative. These beneficial effects are anticipated to be minimal.

There could be short-term impacts on bighorn sheep during relocation of the Charlotte Lake Ranger Station and from project work related to the removal of the Little Five Lakes Ranger Station. Bighorn could be temporarily disturbed by the sights and sounds of project activity, especially if helicopter operations are required.

**Cumulative Effects:** The projects that may affect bighorn sheep that are separate from projects proposed by this WSP/DEIS include research and recovery actions previously described under alternative 1. The cumulative effects would be similar to those described under alternative 1. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

#### **Impacts of Alternative 4: Emphasize Undeveloped Quality and Non-commercial Recreation**

Under alternative 4, there would be beneficial effects on bighorn sheep because visitor use levels would be reduced, stock would be allowed to travel on fewer trails, and party size would be reduced. Stock would be restricted in portions of the Rae Lakes and Dusy Basin watersheds. Off-trail stock use would be slightly reduced from current use from the disallowance of off-trail commercial stock travel. Thus, there would be reduced levels of disturbance, and reduced competition for forage. Overall the effects would be beneficial and long-term; however, the beneficial effects are anticipated to be minimal. For the reasons described previously under “Types of Impacts on Sierra Nevada Bighorn Sheep,” it is probable that beneficial effects would remain below the level of biological significance.

There could be adverse impacts on bighorn sheep during removal of the Charlotte Lake Ranger Station and Bench Lake tent platform. Bighorn sheep could be temporarily disturbed by the sights and sounds of project activity, especially if helicopter operations are required. Impacts would occur from work done at Little Five Lakes Ranger Station within the Big Arroyo herd unit, but it is unlikely that these two activities would be scheduled together.

**Cumulative Effects:** The projects that may affect bighorn sheep that are separate from projects proposed by this WSP/DEIS include research and recovery actions previously described under alternative 1. The cumulative effects would be similar to those described under alternative 1. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under alternative 4 that would constitute a significant cumulative effect.

## Impacts of Alternative 5: Emphasize Opportunities for Solitude

Under alternative 5, there would be decreased use overall. Visitor use levels would be reduced. On-trail stock use would be similar to alternatives 2 and 3; however, stock would not be allowed off-trail except to access overnight camp areas. The reduction in visitor use and the closures of areas to stock would reduce the potential for interactions between humans/stock and bighorn sheep. Under this alternative, bighorn sheep would benefit from reduced forage competition with stock from the closures. The restriction on grazing in off-trail areas would benefit newly reintroduced bighorn sheep in the Big Arroyo herd unit, and in the Laurel Creek herd unit, if bighorn sheep are eventually reintroduced there. These beneficial effects are anticipated to be minimal.

There could be impacts on bighorn sheep during removal of the Bench Lake tent platform and the removal of the Little Five Lakes Ranger Station. Bighorn sheep could be temporarily disturbed by the sights and sounds of project activity, especially if helicopter operations are required.

**Cumulative Effects:** The projects that may affect bighorn sheep that are separate from projects proposed by this WSP/DEIS include research and recovery actions previously described under alternative 1. The cumulative effects would be similar to those described under alternative 1. Considered together, there would be no meaningful additive or interactive effects among these projects and the proposed actions under alternative 5 that would constitute a significant cumulative effect.

## CONCLUSIONS FOR SPECIAL-STATUS SPECIES

**Yosemite toad:** Under alternatives 1, 2, 3, and 5, individual Yosemite toads would continue to be at risk from trampling by visitors and stock. Recreation activities and grazing would continue to cause a slight degradation of Yosemite toad habitat. Current management techniques successfully minimize these impacts. The action alternatives limit stock access in some areas that contain Yosemite toad habitat, lowering the chance of trampling and habitat degradation. Impacts of alternatives 2, 3, and 5 would be similar; alternative 4 would result in the lowest risk to Yosemite toad because all meadows would be closed to grazing. The action alternatives would incorporate mitigation measures designed to minimize impacts.

Frequent impacts on Yosemite toad are not expected under any of the alternatives; however, Yosemite toad populations are generally small and isolated, and thus injury, direct death, or stranding of individual animals has the potential to result in a slight change in the overall population. Because of the potential for mortality, the alternatives would result in a USFWS determination of *may affect, likely to adversely affect* for the Yosemite toad. When considering the intensity of impacts with respect to the laws and policies designed to protect special-status species, impacts on Yosemite toad from the alternatives are not expected to be significant, and thus are not likely to result in jeopardy for the species.

**Mountain yellow-legged frogs:** Under alternative 1, mountain yellow-legged frogs would continue to be at risk from disturbance, trampling, and habitat degradation. All of the action alternatives reduce this risk by restricting stock access and grazing, and reducing the potential for impact from disturbance, trampling, and habitat degradation. Alternative 3 would allow larger party size, potentially increasing the potential for human-frog interactions, while alternative 4 has the most restrictions that reduce impacts on mountain yellow-legged frogs, resulting in the fewest impacts on the mountain yellow-legged frogs. Based on the USFWS determination of impact, all alternatives would result in a *may affect, likely to adversely affect* determination for mountain yellow-legged frogs. While the potential for mortality by trampling exists, the probability is very low and mortality would be highly unlikely to result in population-level risks. This low risk combined with the mitigation measures would make mortality unlikely. In the context of laws and policies that protect special-status species, the impacts of the alternatives would not be significantly

adverse or beneficial, and they would not result in population-level impacts, and thus would be highly unlikely to result in jeopardy for the two species.

**Sierra Nevada bighorn sheep:** Bighorn sheep would continue to be disturbed during hiker and stock interactions but there would be no measurable difference in impacts associated with disturbance across the alternatives. There are few adverse effects on bighorn sheep due to stock interactions at foraging areas; this would be expected to continue across alternatives. All alternatives limit stock access and grazing, with alternative 5 being the most protective of bighorn sheep habitat because of restrictions in off-trail travel by stock. Overall the effects would be beneficial and long term, but for the reason described above under “Types of Impacts on Sierra Nevada Bighorn Sheep,” it is probable that beneficial impacts would remain below the level of biological significance. Based on the information gathered about the effects of hiker and stock use on bighorn sheep, and the actions proposed under the alternatives which may temporarily disturb bighorn sheep, the implementation of the WSP/DEIS would result in a USFWS determination of *may affect, but not likely to adversely affect* for bighorn sheep and could result in a slight modification of critical habitat. In the context of laws and policies that protect special-status species, the impacts of the alternatives would not be significantly adverse or beneficial, and they would not result in population-level impacts, and thus would not result in jeopardy for the Sierra Nevada bighorn sheep.

## CULTURAL RESOURCES

### METHODOLOGY FOR ANALYZING IMPACTS

The following discussion includes analyses of potential impacts from the alternatives in the WSP/DEIS to the four types of cultural resources in Sequoia and Kings Canyon National Parks: archeological resources, historic structures, cultural landscapes, and ethnographic resources. These physical components of the parks’ cultural resources were described separately in chapter 3; however, they are reiterated together here because the distinctions between these four types are not always clear. For example, historic structures and the natural landscape features within which they sit all contribute to those areas defined as cultural landscapes. In addition, the full extent of the archeological and ethnographic resources, many of which also contribute to the cultural landscape, may not be known. Cultural resources in many areas of the parks are composed of all of these types, which may also contribute to those areas defined as cultural landscapes. In addition, many management actions proposed in the alternatives affect a combination of two and sometimes all of these resources. Therefore, the effects of each alternative on all types of cultural resources are discussed below. Information used in this assessment was obtained from available relevant literature and documentation, maps, and consultation with cultural-resource experts, as well as from interdisciplinary team meetings, field trips, and site visits.

Section 106 of NHPA requires that federal agencies take into account the effect of any proposed undertakings on properties that are listed, or eligible for listing, in the National Register. The process begins with identification and evaluation of cultural resources for national-register eligibility, followed by an assessment of effects on eligible resources. This process includes consultation with the California State Historic Preservation Office (CA SHPO) and affiliated American Indian Tribes. If an action could change in any way the characteristics that qualify the resource for inclusion in the National Register, it is considered to have an effect. *No adverse effect* means there could be an effect, but the effect would not be harmful to the characteristics that qualify the resource for inclusion in the National Register. *Adverse effect* means the action could diminish the integrity of the characteristics that qualify the resource for the National Register.

Section 110 of the NHPA requires that federal land managers establish programs in consultation with the respective SHPO to identify, evaluate, and nominate properties to the National Register. This act applies to all federal undertakings or projects requiring federal funds or permits.

The method for assessing effects on cultural resources complies with the requirements of both NEPA and section 106 of NHPA, and with implementing regulations 40 CFR 1500 and 36 CFR 800). The analysis also takes into account that there are differences between NEPA and NHPA. Therefore, the assessment of effects discusses the following characteristics of effects to ensure NEPA compliance:

- Type (beneficial or adverse)
- Duration (short-term, long-term)
- Context of the effect (localized, parks-wide, regional)
- Cumulative nature of the effect

To ensure compliance with section 106 of NHPA, the following considerations were incorporated into the analysis of impacts:

- Determination of the Area of Potential Effect, or APE (800.4[a])
- Identification of historic properties in the APE that are listed or eligible for listing on the National Register (NRHP 800.4[b]-[c])
- Application of the criteria of adverse effect on affected historic properties in the APE (800.5[a][1])

All proposed actions in the plan would be performed in accordance with *NPS-28 Cultural Resource Management Guideline 1998*. Consultation with interested parties would occur in accordance with the 2008 document *Nationwide Programmatic Agreement Among the National Park Service (U.S. Department of the Interior) Nationwide the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers for Compliance with Section 106 of the National Historic Preservation Act*, or as otherwise agreed to in consultation with the CA SHPO. Measures to mitigate any adverse effects of proposed actions would be implemented in consultation with the CA SHPO and would be documented in a memorandum of agreement or the NEPA decision document for this plan. If the NPS, CA SHPO, affected American Indian Tribes and groups (if appropriate), and the Advisory Council on Historic Preservation (ACHP) could not agree on measures to avoid or minimize adverse effects and were unable to negotiate and execute an alternate memorandum of agreement in accordance with 36 CFR 800.6(b), the effect would remain adverse. A summary of effects under NHPA section 106 is included in the impacts analysis of each alternative.

The cultural resources impact analysis is wholly focused on the manner in which the various WSP alternatives would affect archeological resources, historic structures, cultural landscapes, and to the extent possible, ethnographic resources.

**Archeological Resources:** Archeological resources are the remains of past human activity and the records documenting the analysis of such remains (*NPS-28: Cultural Resource Management Guideline 1998*).

Potential impacts on archeological resources are assessed based on the amount of disturbance to an archeological resource and the degree to which the integrity remains or is otherwise lost without recordation of the remains. When appropriate, potential impacts on archeological resources are to be assessed per appendix C of *NPS-28: Cultural Resource Management Guideline 1998; Secretary of the Interior's Standards for Archeological Documentation* (NPS 1998b).

**Historic Structures:** An historic structure is “a constructed work ... consciously created to serve some human activity” (*NPS-28 Cultural Resource Management Guideline 1998*). Of the structures in



wilderness, 22 are currently on the List of Classified Structures, and 17 are listed on the National Register. Of these, only three structures listed or eligible for listing in the National Register would potentially be affected by the alternatives: the Pear Lake Ski Hut, Redwood Meadow Ranger Station, and the Tyndall Ranger Station, thus the effects on these structures will be further evaluated in this section.



**One of the historic cabins, photographed in the early 1990s, left behind by the trapper Shorty Lovelace.**

Adverse effects on historic properties occur when irreparable alterations of features or patterns, including demolition, diminish the overall integrity of the resource so that it no longer qualifies for the National Register. Adverse effects on built-environment historic properties (aboveground buildings and structures) under NHPA section 106 can be addressed with a good-faith effort to consider whether and how to avoid, minimize, or mitigate the effect. This may involve modifying the undertaking, imposing certain mitigation conditions, or other measures negotiated in consultation with the CA SHPO, the ACHP, culturally associated American Indian Tribes and groups, and the public.

This approach is derived from both the Secretary of the Interior’s Standards for the Treatment of Historic Properties as well as the regulations of the ACHP implementing the provisions of section 106 of the National Historic Preservation Act.

**Cultural Landscapes:** According to the *NPS-28 Cultural Resource Management Guideline 1998*, cultural landscapes are “...complex resources that range from large rural tracts covering several thousand acres to formal gardens of less than an acre. Natural features such as landforms, soils, and vegetation are not only part of the cultural landscape; they provide the framework within which it evolves....”

Potential impacts on cultural landscapes, topography, landforms, and vegetation are evaluated in terms of past, present, and future change resulting from implementation of the alternatives. The cultural-

landscapes evaluation addresses anticipated changes to land use, vegetation patterns, circulation systems, locations of structures, topographic features and relief, site elevation, slope orientation, rock exposure, and modification of soil types. Of the seven cultural landscapes described in chapter 3 of this document, six would continue to be protected under all alternatives: the Kern Canyon Ranger Station / Lewis Camp Area, the Barton Lackey Complex, Colony Mill Road, the John Muir Trail, the HST and the “Early Trail System” of Sequoia and Kings Canyon National Parks. Therefore, there would be no impacts on these identified cultural resources.

Adverse effects on cultural landscapes occur when irreparable alterations of features or patterns, including demolition of contributing structures, diminish the overall integrity of the landscape so that it no longer qualifies for the National Register. As stated previously, adverse effects on historic properties under NHPA section 106 can be addressed with a good-faith effort to consider whether and how to avoid, minimize, or mitigate the effect. This may involve modifying the undertaking, imposing certain mitigation conditions, or other measures negotiated in consultation with the CA SHPO, the ACHP, culturally associated American Indian Tribes and groups, and the public.

This approach is derived from both the *Secretary of the Interior’s Standards for the Treatment of Historic Properties* as well as the regulations of the ACHP implementing the provisions of section 106 of the NHPA.

**Ethnographic Resources:** Ethnographic resources are expressions of human culture and the basis of continuity of cultural systems (*NPS-28 Cultural Resource Management Guideline* 1998). Ethnographic resources can include sites, structures, objects, traditional landscapes, or a natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a traditionally associated group. An ethnographic overview and assessment is lacking at Sequoia and Kings Canyon National Parks; therefore, information collected as part of the Multipark Ethnographic Overview for Sequoia and Kings Canyon National Parks, Yosemite National Park, and Devils Postpile National Monument, underway in 2014, will be considered as the planning process continues. This information will enhance formal consultation with American Indian Tribes and organizations and will better inform management priorities and resource decisions.

## **TYPES OF IMPACTS ON CULTURAL RESOURCES**

Visitors can intentionally or inadvertently affect cultural resources by trampling, vandalizing, or removing them. Park staff can also unintentionally affect cultural resources by trampling resources, as can stock. The intentional removal of historic structures would have a direct and long-term adverse impact on the structure and potentially alter the cultural landscape. Installing equipment or new structures or re-routing/upgrading trails would require surveys so that resources can be avoided or impacts can be minimized. These types of actions are considered in the assessment of impacts on cultural resources.

## **IMPACTS COMMON TO ALL ALTERNATIVES**

Archeological resources, historic structures, cultural landscapes, and known ethnographic resources would be managed in accordance with the NHPA and other laws, regulations, and directives that direct the NPS to protect cultural resources and make reasonable efforts to minimize any damage that may occur to the resources. This would result in long-term beneficial effects on cultural resources throughout the parks’ wilderness.

The parks would continue the practice of research, survey, and consultation to determine the location, integrity, and national-register eligibility of historic structures, cultural landscapes, and archeological and ethnographic sites. Newly located national-register-eligible resources would be managed to protect their

integrity and minimize damage. Overall, this would result in a beneficial long-term impact on cultural resources.

Trailhead and stock-use quotas are considered in all alternatives. Regardless of whether the alternative proposes an increase or reduction in trail use, the impacts on archeological resources would be negligible because the trails are located in previously disturbed areas. There would be minimal-to-no impact on historic structures, cultural landscapes, or ethnographic resources from changes in trail quotas.

Under all alternatives, trails would be classified and maintained to Class 1, 2, or 3 standards, as described by the U.S. Forest Service's *Trail Classification System*.

Establishing a trail-classification system in itself would not have any impacts on cultural resources, but upgrading or downgrading trails among the classes would potentially affect cultural resources. Upgrading and constructing new trails would likely require excavation, which could expose undiscovered archeological resources. Impacts would be minimized due to the fact that the trails would be surveyed for resources before construction begins and cultural resources would be avoided to the greatest extent possible. Any adverse impacts on newly located resources would be mitigated in consultation with the CA SHPO. Overall, the impacts on archeological resources from trail construction would be permanent, localized, and adverse.

Maintenance of trails would be based upon the class of trail and level of use. Regular trail maintenance, including removal of hazard trees, downed wood, and rocks; erosion control; trail reconstruction; and clearing of brush would occur under all alternatives. These actions would have no adverse impacts on cultural resources. The trails are in previously disturbed areas so it is unlikely that maintenance operations would disturb archeological resources. The process of assessing the eligibility of trails for listing on the National Register has yet to be comprehensively addressed. However, the majority of trails are proposed to be formally assessed as cultural landscapes. Regular maintenance would result in beneficial effects on the integrity of the trails because they would be reasonably protected from degradation.

Trail maintenance also involves the repair and reconstruction of trail structures, such as bridges, and minor realignments. As previously mentioned above, few of the trails in wilderness have been formally evaluated for national register eligibility; however, the parks consider several trails potentially significant, both nationally and locally. Any realignments or structure reconstruction on trails would have the potential to result in adverse impacts on historic structures and features, but any work with the potential to affect the resources would be conducted so as to minimize impacts. Any adverse impacts on historic structures and features from trail maintenance would be localized, and long-term.

Cultural resources at the parks would be impacted by some general actions. Hiking, stock use, grazing, and camping activities (on- and off-trail), whether for recreational or administrative purposes, have the potential to inadvertently affect cultural resources. Moreover, resources in remote areas are subject to vandalism and degradation. These activities result in adverse impacts and would continue under all alternatives. Overall, the intensity of the impacts would be long-term and park-wide.

Any changes to frontcountry facilities would require separate design and compliance. Any adverse impacts on located cultural resources would be mitigated in consultation with the CA SHPO. Resulting adverse impacts on historic structures, cultural landscapes, archeological and ethnographic resources from construction would be localized and long-term.

## IMPACTS OF ALTERNATIVE 1: NO-ACTION / STATUS QUO

The discussion that follows provides an analysis of impacts on cultural resources as a result of alternative 1. The analysis details specific impacts that are not described in the common-to-all section, and the detailed discussion is provided by element.

Wilderness, in the no-action alternative, would be managed under the guidelines of the parks' GMP, BMP, and SUMMP. The use of established areas and infrastructure, such as trails, designated campsites, food-storage boxes, privies, administrative structures, camps, and pastures would continue as appropriate. Cultural resources in wilderness would continue to be protected, monitored, and maintained to ensure their stability and integrity. These actions would continue to provide a parks-wide, long-term, beneficial effect on cultural resources. Impacts on archeological sites, historic structures, cultural landscapes, and known ethnographic resources would continue to be assessed prior to development, and any adverse impacts would be avoided or minimized in consultation with the CA SHPO. Any adverse impacts would be long-term, and localized or park-wide.

**Cumulative Effects:** Other than those ongoing projects and activities associated with the administration of wilderness (i.e., trail maintenance and visitor-use management), there are few past, present, or future foreseeable projects in the parks' wilderness that have a detectable effect on cultural resources.

Past, present, and future projects that involve the installation of equipment or structures, or result in ground disturbance in wilderness, have the potential to inadvertently impact archeological and/or ethnographic resources. Resources management and science projects may include research activities, rehabilitation projects, and invasive-species management. All projects that involve ground disturbance, such as the Natural Resources Conservation Service soils mapping project, the Halstead Meadow Restoration (ongoing), and the Cahoon Meadow restoration project (future), require site-specific identification of cultural resources and consultation with the CA SHPO to minimize adverse impacts.

One plan in particular has the potential to inadvertently impact cultural resources, the Sequoia and Kings Canyon National Parks Fire and Fuels Management Plan (2003). Under this plan, some fires are suppressed and others (natural fires) are allowed to burn. Fire suppression can have a localized, adverse impact on cultural resources due to inadequate time to conduct surveys and to identify and plan for avoiding resources. Allowing fire to burn could result in localized, adverse impacts on archeological and ethnographic resources, structures, and cultural landscapes. For all cultural resource types these effects would be long-term; however, the natural environment component of a cultural landscape would recover with time.

On a regional scale, it is important to consider the effects of past, present, and future foreseeable actions that may affect cultural resources in adjacent USFS lands, and in Yosemite National Park. One element that may affect resources on a regional scale is the potential removal or reduction of High Sierra Camps at Yosemite National Park. As Yosemite National Park develops their wilderness stewardship plan, there may be alternatives that consider changes in the management of the five High Sierra Camps, or the reduction in the size, or the removal of these camps. Under the no-action alternative, the High Sierra Camp at Bearpaw Meadow would remain and continue to be operated. Considered together there would be no meaningful additive or interactive effects among these projects and the continued actions under this alternative that would constitute a significant cumulative effect.

**Section 106 Summary:** In accordance with the regulations of the ACHP (36 CFR 800.5) that address the criteria of effect and adverse effect, the determination of effects under this alternative would result in *no adverse effect*.

## **IMPACTS OF ALTERNATIVE 2: PROTECT WILDERNESS CHARACTER BY IMPLEMENTING SITE-SPECIFIC ACTIONS (NPS PREFERRED ALTERNATIVE)**

The discussion that follows provides an analysis of impacts on cultural resources as a result of alternative 2. The analysis describes specific impacts associated with this alternative that are not included in the “Impacts Common to All Alternatives” section.

There could be new construction associated with this alternative; trails could be constructed or upgraded. New campsites or camp areas could be established. Stock camps could be designated in selected areas. Privies could be constructed at popular areas. These actions could impact cultural resources, especially archeological and ethnographic resources. Any construction, however, would require a cultural resources survey and if National Register-eligible resources are identified, the construction would be sited to avoid the resources. Therefore, any impacts on National Register-eligible cultural resources would be avoided.

Some privies and food-storage boxes could be removed. There would be no impacts on archeological resources from these actions because the boxes and privies are in previously disturbed areas. None of the structures considered for removal are eligible for the National Register. Therefore, there would be no impact on historic structures. The removal of any contributing element to a cultural landscape would require consultation with the CA SHPO and adverse impacts would be avoided.

The Mission 66-era ranger station at Bearpaw Meadow would be removed. A new station would be reconstructed to better meet the area’s historic character. However, since the ranger station is considered a contributing element to the National Register-eligible cultural landscape, its removal would result in a long-term adverse impact on the cultural landscape. The level of impact could be somewhat mitigated through documentation strategies developed in consultation with the CA SHPO.

The historic ranger stations and patrol cabins at Redwood Meadow, Simpson Meadow, and Tyndall would be retained under this alternative. The Pear Lake Ski Hut would continue to be operated in the winter. This alternative continues current types and levels of use and would, therefore, result in no impact on these historic structures.

**Cumulative Effects:** Other than those ongoing projects and activities associated with the administration of wilderness (i.e., trail maintenance and visitor-use management), there are few past, present, or future foreseeable projects in the parks’ wilderness that have a detectable effect on cultural resources. As stated previously, research and resource management projects may affect cultural resources. There are two meadow restoration projects that include ground disturbance, along with the soils mapping project. In addition, the fire management program may affect cultural resources. This alternative would result in impacts that are not substantially different from the status quo (alternative 1) with some widespread beneficial effects on cultural resources from increased knowledge, which allows for increased protection. There would be a localized adverse effect on the cultural landscape at the Bearpaw Meadow High Sierra Camp. Considered together there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

**Section 106 Summary:** In accordance with the regulations of the ACHP (36 CFR 800.5) that address the criteria of effect and adverse effect, the determination of effects under this alternative would result in *adverse effect* on the Bearpaw Meadow High Sierra Camp cultural landscape. There would be *no adverse effect* on any other cultural resource.

### **IMPACTS OF ALTERNATIVE 3: PROVIDE MORE OPPORTUNITIES FOR PRIMITIVE RECREATION**

The discussion that follows provides an analysis of impacts on cultural resources as a result of alternative 3. The analysis describes specific impacts associated with this alternative that are not included in the “Impacts Common to All Alternatives” section.

There would be new construction associated with this alternative. Some existing food-storage boxes would be relocated to protect resources and additional boxes may be added in popular areas. Existing privies would be retained and additional privies could be constructed in popular areas. New campsites could be established. These actions could impact cultural resources, especially archeological resources or cultural landscapes. Any construction, however, would require a cultural resources survey and if National Register-eligible resources are identified, the construction would be sited to avoid the resources or so as to be sensitive to an existing cultural landscape. Therefore, any impacts on National Register-eligible cultural resources would be avoided.

The alternative proposes a range of management prescriptions for Bearpaw Meadow High Sierra Camp. The Mission 66-era ranger station at Bearpaw Meadow would be removed; a new station would be constructed outside the historic district. The ranger station is considered a contributing element to the National Register-eligible cultural landscape. The removal of the ranger station would result in a localized, long-term, adverse impact on the cultural landscape. The Bearpaw Meadow High Sierra Camp would be retained and the expansion of facilities would be considered. The expansion has the potential to adversely impact the cultural landscape. Any changes to the camp would be planned in consultation with the CA SHPO, and the level of impact could be somewhat mitigated through documentation strategies developed in consultation. Nonetheless, the level of impact from development within the cultural landscape would be localized, long-term, and adverse depending on the nature of the modifications.

There would be no impacts on the Pear Lake Ski Hut; even with increased use levels. There would be no change to the management of the historic ranger stations at Tyndall, Redwood Meadow and Simpson Meadow under alternative 3.

**Cumulative Effects:** Other than those ongoing projects and activities associated with the administration of wilderness (i.e., trail maintenance and visitor-use management), there are few past, present, or future foreseeable projects in the parks’ wilderness that have a detectable effect on cultural resources. These effects are described under alternative 1. This alternative would result in impacts that are not substantially different from the status quo (alternative 1) with some widespread beneficial effects on cultural resources from increased knowledge, which allows for increased protection. There would be a localized adverse effect on the cultural landscape at the Bearpaw Meadow High Sierra Camp. Considered together there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

**Section 106 Summary:** In accordance with the regulations of the ACHP (36 CFR 800.5) that address the criteria of effect and adverse effect, the determination of effects under this alternative would result in an *adverse effect* on the Bearpaw Meadow High Sierra Camp cultural landscape. There would be *no adverse effect* on any other cultural resources.

## **IMPACTS OF ALTERNATIVE 4: EMPHASIZE UNDEVELOPED QUALITY AND NON-COMMERCIAL RECREATION**

The discussion that follows provides an analysis of impacts on cultural resources as a result of alternative 4. The analysis describes specific impacts associated with this alternative that are not included in the “Impacts Common to All Alternatives” section.

All grazing would be discontinued under this alternative. This would result in a beneficial effect on unrecorded cultural resources in meadows because they would be less vulnerable to inadvertent damage. However, new areas would be used for holding and feeding stock, thus could result in new areas of disturbance, resulting in inadvertent damage to cultural resources.

Most existing privies and food-storage boxes would be removed. There would be no impacts on archeological resources from these actions because the boxes and privies are in previously disturbed areas. None of the structures considered for removal are National Register-eligible; therefore, there would be no impact on historic structures.

All designated campsites would be removed from Emerald and Pear lakes, Lower Paradise Valley, and at Bearpaw Meadow. No other sites would be designated. There would be no impacts on archeological resources from these actions because the campsites and privies are in previously disturbed areas. None of the structures considered for removal are eligible for the National Register. Therefore, there would be no impact on historic structures.

The alternative proposes the complete removal of the Bearpaw Meadow High Sierra Camp. The Mission 66-era Ranger Station at Bearpaw Meadow would also be removed. This area comprises a National Register-eligible cultural landscape. The removal of the facilities would result in a permanent adverse impact on the cultural landscape. The level of impact could be somewhat mitigated through documentation strategies developed in consultation with the CA SHPO.

There would be localized, long-term, adverse impacts on those ranger stations to be removed that are listed or eligible for listing on the National Register – the Redwood Meadow Ranger Station, Simpson Meadow patrol cabin, and the Tyndall Ranger Station. The level of impact could be somewhat mitigated through documentation strategies developed in consultation with the CA SHPO.

The winter commercial services at the Pear Lake Ski Hut would be discontinued, but the ranger station would continue to be maintained as a cultural resource. Therefore, there would be no effect on this historic structure.

**Cumulative Effects:** Other than those ongoing projects and activities associated with the administration of wilderness (i.e., trail maintenance and visitor-use management), there are few past, present, or future foreseeable projects in the parks’ wilderness that have a detectable effect on cultural resources. The impacts would be the same as described under alternative 1. This alternative would result in an adverse effect by removing one cultural landscape (Bearpaw Meadow High Sierra Camp), and removing three historic structures. If the High Sierra camps are reduced in size or removed elsewhere in the region, this alternative combined with the regional effects, could constitute a significant adverse effect on those resources.

**Section 106 Summary:** In accordance with the regulations of the ACHP (36 CFR 800.5) that address the criteria of effect and adverse effect, the determination of effects under this alternative would result in an *adverse effect* on the Bearpaw Meadow High Sierra Camp cultural landscape and the ranger stations



(patrol cabins) at Redwood Meadow, Simpson Meadow, and Tyndall. There would be *no adverse effect* on any other cultural resources.

### **IMPACTS OF ALTERNATIVE 5: EMPHASIZE OPPORTUNITIES FOR SOLITUDE**

The discussion that follows provides an analysis of impacts on cultural resources as a result of alternative 5. The analysis describes specific impacts associated with this alternative that are not included in the “Impacts Common to All Alternatives” section.

There would be no new construction in wilderness associated with this alternative. Therefore, there would be no construction-related impacts on National Register-eligible cultural resources under alternative 5.

All existing privies and food-storage boxes would be removed. There would be no impacts on archeological resources from these actions because the boxes and privies are in previously disturbed areas. None of the structures considered for removal are National Register-eligible; therefore, there would be no impact on historic structures.

All designated campsites would be removed from Emerald and Pear lakes, Lower Paradise Valley, and at Bearpaw Meadow. No other sites would be designated. There would be no impacts on archeological resources from these actions because the campsites and privies are in previously disturbed areas. None of the structures considered for removal are National Register-eligible; therefore, there would be no impact on historic structures.

The alternative proposes the removal the Mission 66-era Ranger Station at Bearpaw Meadow. The ranger station and Bearpaw Meadow High Sierra Camp are elements of a National Register-eligible cultural landscape. The removal would therefore result in a localized, long-term, adverse impact on the cultural landscape. The level of impact could be somewhat mitigated through documentation strategies developed in consultation with the CA SHPO. Other than the Bearpaw Meadow Ranger Station, there would be no other historic ranger stations or patrol cabins removed or modified.

The winter commercial services at the Pear Lake Ski Hut would be discontinued; winter use of the facility as a warming hut would be managed by the NPS. The ranger station would continue to be maintained as a cultural resource. Therefore, there would be no effect on this historic structure.

**Cumulative Effects:** Other than those ongoing projects and activities associated with the administration of wilderness (i.e., trail maintenance and visitor-use management), there are few past, present, or future foreseeable projects in the parks’ wilderness that have a detectable effect on cultural resources. These effects are described under alternative 1. This alternative would result in an adverse effect by modifying one cultural landscape. Considered together there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect.

**Section 106 Summary:** In accordance with the regulations of the ACHP (36 CFR 800.5) that address the criteria of effect and adverse effect, the determination of effects under this alternative would result in an *adverse effect* on the Bearpaw Meadow High Sierra Camp cultural landscape. There would be *no adverse effect* on any other cultural resources.



## CONCLUSION

All of the alternatives protect cultural resources to a varying degree. The adverse effects from the action alternatives relate to the removal of historic structures. The historic ranger stations are best preserved in alternatives 1, 2, 3, and 5. Alternative 4 would result in an adverse effect on three historic ranger stations.

Alternative 1 would provide the most protection to the Bearpaw Meadow High Sierra Camp. Under alternatives 2, 3, and 5, the Bearpaw Meadow High Sierra Camp would be adversely affected by the removal of a contributing feature, the Bearpaw Meadow Ranger Station. In addition, under alternative 3, the development could be slightly expanded, which could also result in an adverse effect on this resource. Alternative 4 would result in the complete removal of the Bearpaw Meadow High Sierra Camp, which would result in a permanent adverse effect on this cultural resource. In addition, if Yosemite National Park, through its planning process, decides to remove High Sierra camps, this would result in a region-wide adverse cumulative effect on these historic resources.

Any changes to cultural resources would be planned in consultation with the CA SHPO, and the level of impact could be somewhat mitigated through documentation strategies developed in consultation. Nonetheless, the level of impact from modifications or the removal of cultural properties would be localized, long-term, and adverse. CEQ suggests that adverse effects on a cultural district or landscape that is eligible for listing on the National Register of Historic Places is a consideration when determining the level of significance. The removal of the entire Bearpaw Meadow High Sierra Camp, thus, could be deemed significant; this would depend upon the results of consultations with SHPO.

## SOCIOECONOMICS

NPS Director's Order 12: *Environmental Impact Analysis* requires units of the NPS to consider social and economic impacts of a planning action as directed by CEQ regulations. CEQ defines the human environment as the natural and physical environment, and the relationship of people with that environment (1508.14). Socioeconomic impacts include those to minority and low-income communities as specified in Executive Order 12898, "Environmental Justice" (Feb. 11, 1994); however, this topic area was dismissed from detailed consideration (see chapter 1).

## METHODOLOGY FOR ANALYZING IMPACTS

Potential economic and social implications of the Sequoia and Kings Canyon National Parks WSP/DEIS alternatives were identified as a topic of public interest. Economic effects are commonly expressed in terms of the number and types of jobs supported directly and indirectly by the parks, changes in income, and changes in visitor spending resulting from changes in visitor use. Examples of social impacts include effects on local and regional population growth, housing, and community facilities and services.

The current assessment focuses on the two primary factors most likely to vary among the alternatives and have socioeconomic consequences in the region:

- 1) Changes in the levels of wilderness visitor use and spending at the parks and in the surrounding region, including changes in the commercial services offered within the parks.
- 2) Future NPS expenditures for rehabilitation, restoration, and maintenance of wilderness-related recreation and administrative facilities.

Management actions to implement the alternatives would likely be achieved through reprioritization and reallocation of available funding. Future expenditures would reflect NPS policies, actual on-the-ground

conditions, unforeseen events and opportunities, and budgets approved by Congress for the NPS in general, and for Sequoia and Kings Canyon National Parks specifically.

Management guidance and restrictions established through the WSP/DEIS would be expected to have limited effects on the overall wilderness use under any of the action alternatives. Current use is estimated at approximately 111,000 overnight visitors per year (see the “Visitor Use and Experience” section in chapter 3). Expected changes in future visitor use are not quantitative but rather reflective of the relative order in visitation changes expected under each alternative (alternative 5 allowing the least use among the alternatives and alternative 3 allowing the highest annual use). Actual visitor use over time will exhibit temporary and multi-year variations due to factors such as weather and regional or national economic fluctuations.

## **IMPACT CHARACTERIZATION AND SIGNIFICANCE FOR SOCIOECONOMICS**

Economic and social impact significance associated with the WSP/DEIS alternatives are assessed in terms of scale/intensity, duration, and type/character. These parameters are defined as follows.

**Scale/Intensity:** In addition to the relative magnitude of changes, factors considered in assessing scale and intensity of impacts associated with the WSP/DEIS alternatives include the likelihood of the public awareness of the effects of the changes, the ability to measure the effects, and the number of people or extent of the geographic region that would be affected.

**Duration:** Social and economic changes associated with management actions under an alternative may be temporary or persist for an extended time. Temporary impacts may be noticeable locally but not result in long-term changes of underlying economic and social conditions. Long-term impacts, on the other hand, may lead to changes in the economic base, trigger construction or closure of public facilities and changes in service levels, affect local real estate markets and how individuals and groups relate to one another, and other changes in established social interactions. The distinguishing characteristics associated with duration are described below.

**Short-term:** Short-term effects typically occur during and in response to planning, design, construction and major maintenance of buildings, trails, parking lots and other facilities. The effects commonly diminish or disappear after the activity is completed. Multiple “short-term” periods could occur within an extended time horizon, such as the life of the WSP, as distinct actions implemented over time, could each trigger short-term effects.

**Long-term:** Long-term effects, which may not begin until after completion of direct activities associated with the initial changes in management, generally last many years, and may extend indefinitely into the future. Such effects may include changes in the base budget for park operations and maintenance and effects related to changes in visitation over time.

**Type/Character:** Social and economic consequences may be beneficial, adverse or indeterminate. The key characteristics of effects that determine the type/character of effects are described below.

**Beneficial:** Effects that many individuals or groups would accept or recognize as improving economic or social conditions, either in general or for a specific group of people, businesses, or organizations. Examples of beneficial effects include increases in job opportunities and personal income, lower unemployment, and contributions to economic and social diversity and sustainability.

**Adverse:** Effects that most individuals or groups accept or generally recognize as diminishing economic or social welfare, either in general or for a specific group of people, businesses, or organizations. Examples of adverse effects include fewer job opportunities, reductions in visitor

expenditures for local businesses, or an erosion of fiscal resources to fund public facilities and services.

**Indeterminate:** Those effects for which the size, timing, location, or individuals or groups that would be impacted cannot be determined, or those which include both beneficial and negative effects, in some instances affecting different communities or populations, such that the net effect is indeterminate.

## **ANALYSIS OF IMPACTS ON SOCIOECONOMICS**

Implementation of the no-action or any of the action alternatives would occur concurrently with other economic, demographic, and social changes in the region. Information collected as part of the NPS Visitor Services Project showed that California residents account for approximately two-thirds of the overall visitation to the parks, and the parks' wilderness staff are of the opinion that California residents comprise at least a comparable share of wilderness use.

Long-term population forecasts prepared by the California Department of Finance anticipate a net population increase of 54% in the region by 2040, and an increase of 28% statewide. The latter equates to nearly 10.4 million additional residents by 2040. This projected population growth is not viewed as a precursor to comparable increases in wilderness use, both because trailhead permits and quotas regulate actual use and because there is a historical trend of declining or steady use of the parks' wilderness during periods in which substantial population growth occurred. Instead, the projected population growth is viewed as indicative of continued long-term demand for wilderness and wilderness experience of the type provided by the parks and other nearby wilderness.

### **IMPACTS OF ALTERNATIVE 1: NO-ACTION / STATUS QUO**

Continuation of the current permit system and quotas under the no-action alternative could serve to constrain visitor use during peak periods. Consequently, annual wilderness use at the parks under the no-action alternative may increase, but not substantially. Major long-term decreases are not anticipated either.

Changes in spending by wilderness visitors at local stores, motels and hotels, and other tourism-related businesses and attractions (including wilderness guides and outfitters) would generally mirror any changes in the levels of visitor use. Most of any changes in spending would accrue to businesses located in the gateway communities serving as staging areas for overnight wilderness trips, the stock guides and other businesses operating in the parks under CUAs. Although the gross income derived from visitors using private stock, commercial dunnage, and other guide and outfitter services is critical to the continued economic viability of individual guides and outfitters, total expenditures associated with wilderness use represent a very small portion of the overall regional economy. The economic stimulus associated with wilderness use would remain highly seasonal under alternative 1.

State and local governments would experience little changes in sales taxes and other revenues in response to changes in visitor spending under the no-action alternative.

Implementing the no-action alternative would contribute to the parks' sustained economic infusion to the region over the life of the WSP. The infusion would result from ongoing park operating expenditures, including staff payroll, one-time capital outlays, and environmental research and restoration projects associated with wilderness. NPS maintenance staff would perform much of the work to address maintenance and preservation, restoration, and rehabilitation activities. The no-action alternative would not, however, necessitate or support any substantive changes or reprioritization of budgeted resources to fund park operations in wilderness.

Little change in park related demands on community services and facilities across central California would result from the no-action alternative. The parks would not become a direct catalyst for regional population growth under the no-action alternative. The influence of the parks' wilderness management on community attitudes and lifestyles would not alter dramatically under the no-action alternative.

At the regional level, the socioeconomic effects related to park wilderness visitors and park operations would be both beneficial and adverse, but there would be little change in the short and long term.

**Cumulative Effects:** From the economic and social perspectives, the parks cannot be readily isolated from past, present, and future development in the surrounding areas. Past human activity and development in the parks and surrounding region were instrumental in establishing existing land use and ownership patterns, which are also tied to the cultural and historical landscapes. But for establishment of the parks, the affected lands would undoubtedly provide far fewer opportunities for public use and natural resource protection. Social and economic effects of the above actions are reflected in the human settlement patterns, community development, road network, traffic, and the seasonal resident and visitor populations associated with the parks.

Social and economic effects of ongoing and planned frontcountry management at the parks could result in short- and long-term economic effects on visitor-related businesses due to changes in visitor-use levels and distribution. Most other ongoing and foreseeable future projects in wilderness have little or no potential for economic and social effects beyond temporary indirect effects associated with the expenditures and application of labor and other resources to completing restoration and maintenance activities. Issuance of the concessions prospectus for Sequoia National Park could result in operational changes of the Bearpaw Meadow High Sierra Camp that could affect wilderness use and the economic contributions therefrom, as could management actions resulting from the future completion of the Yosemite National Park wilderness stewardship plan, and updates of land management plans for nearby national forests. The net effect of those actions is unknown, but potentially of more consequence than the effects under the no-action alternative. Combined with these effects, the no-action alternative would result in limited short- and long-term beneficial and adverse cumulative impacts. The no-action alternative would comprise a small portion of these overall cumulative impacts.

## **IMPACTS OF ALTERNATIVE 2: PROTECT WILDERNESS CHARACTER BY IMPLEMENTING SITE-SPECIFIC ACTIONS (NPS PREFERRED ALTERNATIVE)**

Implementation of alternative 2 would occur against the previously described backdrop of economic, demographic, and social conditions across the region, including substantial population growth through 2040. Alternative 2 would add another set of influences, albeit virtually indiscernible, affecting the region's economic and social environment, but would leave the basic foundations of the area's economic and demographic outlook unchanged.

Wilderness management actions under alternative 2 would accommodate about the same overall use levels. However, the more direct consequences of the restrictions placed in the busiest areas of wilderness, such as limits on commercial services in the Mount Whitney Management Area, and limits on grazing in some additional areas, could result in lower use and the redistribution of use geographically.

The net effects on visitor use, a key driver of potential socioeconomic effects associated with the plan, are unclear, depending on public response to limits on commercial services and grazing. For instance, visitors who are unable to obtain a permit for their preferred destination may decide to go to an alternative destination, shift their planned visit to a time period for which a permit for their preferred destination is available, or cancel their plans. The portion of visitors who will choose each of these reactions is unknown; thus, shifts in visitor use are uncertain. Shifts in destination or time could actually result in

higher use, whereas cancellations would reduce use. The reductions in party size limits proposed for some uses and locations would reduce use slightly. Stock use would similarly be subject to offsetting tendencies from the designation of additional stock use areas. Whether the net long-term effect on visitor use would result in decreasing, stable, or increasing visitation relative to the no-action alternative is unknown, but is likely to be of limited magnitude in any event.

The effects on local socioeconomic conditions are also indeterminate. Higher use and visitor spending could translate into higher economic contributions in the region, including incremental increases in seasonal employment. There would be no reduction in commercial services wilderness-wide under this alternative; however, there would be a limited reduction in commercial service allocations for both stock and non-stock service providers in the Mount Whitney Management Area. Although the net effects are indeterminate, some individuals and businesses are likely to be adversely affected by the reduction in allocations in the Mount Whitney Management Area, and some individuals and businesses would not be affected. Reduced commercial services in the Mount Whitney Management Area could reduce income for some outfitters, but over time these effects would probably be mitigated by a shift in commercially supported visitor use to other areas of the parks' wilderness.

Implementing alternative 2 would contribute to the parks' sustained economic infusion to the region over the life of the WSP. The infusion would result from ongoing operating expenditures, including staff payroll, capital outlays, and environmental research and restoration projects associated with wilderness. Alternative 2 would not necessitate or support substantive changes or reprioritization of budgeted resources to fund park operations in wilderness. NPS maintenance staff would perform much of the work to address maintenance and preservation, restoration, and rehabilitation activities. Consequently, management actions to implement the actions would likely be achieved through reprioritization and reallocation of available funding.

Short-term increases in seasonal employment and spending would result if the parks secured additional funds in response to completion of the plan. The availability, timing, and amount of such funds are uncertain and depend on budgetary approvals by Congress. Budget allocations within the NPS produce long-term effects on employment, business sales, income, and other related measures.

Regardless of the net effects on visitor use and spending and the parks' operating and maintenance spending, the economic contributions to the regional economy would remain highly seasonal.

The effects of wilderness visitor use and park management on state and local governments would be essentially the same under alternative 2 as under the no-action alternative. Changes in wilderness use under alternative 2 would not be a direct catalyst for changes in regional population. Little change in park-related demands on community services and facilities across central California would result from implementing alternative 2. The influence of the parks' wilderness management on community attitudes and lifestyles would not alter dramatically under alternative 2.

**Cumulative Effects:** Implementation of alternative 2 would occur against the same set of past, ongoing and future conditions and influences described for the no-action alternative above.

Social and economic effects of ongoing and planned frontcountry management at the parks could result in short- and long-term economic effects on visitor-related businesses due to changes in visitor-use levels and distribution. Most other ongoing and foreseeable future projects in wilderness have little or no potential for economic and social effects beyond temporary indirect effects associated with the expenditures and application of labor and other resources from completing restoration and maintenance activities. Issuance of the concessions prospectus for Sequoia National Park could result in operational changes of the Bearpaw Meadow High Sierra Camp that could affect wilderness use and the economic

contributions therefrom, as could management actions resulting from future completion of the Yosemite National Park Wilderness Stewardship Plan and updates of land management plans for nearby national forests. The net effects of those actions on visitor use and associated economic contributions are unknown, but they are potentially of comparable or greater consequence than the effects under alternative 2.

The contributions of alternative 2 to the cumulative economic and social effects, including those associated with increased visitor and NPS operating expenditures, would be perceptible on a localized scale in both the short and long term and are indeterminate in nature. Impacts of alternative 2 would comprise a small portion of these overall cumulative social and economic effects.

### **IMPACTS OF ALTERNATIVE 3: PROVIDE MORE OPPORTUNITIES FOR PRIMITIVE RECREATION**

Implementation of alternative 3 would occur against the previously described backdrop of economic, demographic, and social conditions across the region, including substantial population growth through 2040. Alternative 3 would add another set of influences, albeit virtually indiscernible, affecting the region's economic and social environment, but would leave the basic foundation of the area's economic and demographic outlook unchanged.

Wilderness management actions under alternative 3 would accommodate some increase in overall use levels through moderate increases in use in some popular areas and expanded opportunities for commercial service providers (i.e., increased allotments wilderness-wide). The allotment for commercial service providers in the Mount Whitney Management Area would be higher under this alternative than the other action alternatives.

The net long-term effect of alternative 3 on visitor use, a key driver of potential socioeconomic effects associated with the WSP, is expected to be an increase in overall wilderness use. Overall spending by wilderness visitors would increase over the long term under alternative 3 due to the increase in use and expanded commercial opportunities. The reductions in consecutive night limits proposed for some locations may discourage some use.

Spending by wilderness visitors at local stores, motels and hotels, and other tourism-related businesses and attractions would likely increase over time compared to the other alternatives. Much of the additional spending would be captured by recreation-oriented businesses located in the gateway communities serving as staging areas for overnight wilderness trips and by the guides, outfitters and other businesses that operate in the parks under CUAs. The economic stimulus associated with wilderness use would remain highly seasonal. State and local governments could collect incrementally higher sales taxes and other revenues from the increases in visitor spending under alternative 3 than under the no-action alternative, but the overall contribution of such revenues to overall receipts would be slight.

Wilderness use in the parks would not be a direct catalyst for regional population growth under alternative 3. Little change in park-related demands on community services and facilities across central California would result from implementing alternative 3. Alternative 3 would not be expected to dramatically alter the influence of the parks' wilderness management on community attitudes and lifestyles.

Implementing alternative 3 would contribute to the parks' sustained economic infusion to the region over the life of the plan. The infusion would result from ongoing park operating expenditures, including staff payroll, one-time capital outlays, and environmental research and restoration projects associated with wilderness.

No major changes in budgeted resources to fund park operations in wilderness would be anticipated under alternative 3. NPS maintenance staff would perform much of the work to address maintenance and preservation, restoration, and rehabilitation activities. Management actions to implement alternative 3 would be achieved through reprioritization and reallocation of existing funds. A series of short-term increases in seasonal employment and spending would result if the parks successfully gain access to additional funds. Additional funding could speed the implementation of the actions under this alternative.

At the regional level, the socioeconomic effects related to park wilderness visitors and park wilderness operations under alternative 3 would be beneficial in the short and long term.

**Cumulative Effects:** The social and economic effects from other projects would be the same under alternative 3 as under alternative 2 (see above). From the economic and social perspectives, the contributions of alternative 3 to the cumulative economic and social effects, including those associated with increased visitor and NPS operating expenditures would be discernible in a localized area in the short and long term, similar to those under the no-action and alternative 2. Impacts of alternative 3 would comprise a small portion of these overall cumulative social and economic effects.

#### **IMPACTS OF ALTERNATIVE 4: EMPHASIZE UNDEVELOPED QUALITY AND NON-COMMERCIAL RECREATION**

Implementation of alternative 4 would occur against the same backdrop of economic, demographic, and social conditions across the region described above for the no-action. Alternative 4 would add another set of influences, albeit inconsequential, affecting the region's economic and social environment, but would leave the basic foundation of the area's economic and demographic outlook unchanged.

Wilderness management actions under alternative 4 would generally constrain use in some popular areas, overall use levels would remain similar to current conditions, though there could be reduced use levels in the highest use areas. The removal of food-storage boxes, privies, the required use of waste pack-out kits, and reductions in the extent of areas where campfires are allowed could discourage some future wilderness use and encourage use by others who appreciate unscarred natural environments. The element of alternative 4 with the most prevalent effects is the net reduction of commercial services wilderness-wide, with the greatest reduction of commercial services in the Mount Whitney Management Area when compared with the other action alternatives.

The level of commercial services, both stock and non-stock use under alternative 4 would decline in the long term due to the reduced allotment, combined with the reduced on- and off-trail party sizes, and new grazing restrictions. These effects could reduce income for outfitters, adversely affecting the long-term economic viability of some outfitters, potentially to the point that one or more outfitters may choose to forego pursuit of CUAs. Such a decision could have indirect economic and social effects in community(ies) that serve as the base of operations for those outfitters, such as reduced demand for lodging and restaurant expenditures by clients before and after their trips. These in turn could adversely affect seasonal employment opportunities in those communities.

The net long-term effect of alternative 4 on visitor use, a key driver of potential socioeconomic effects associated with the plan is indeterminate, but would likely be a net decline. Overall spending by wilderness visitors would be lower under alternative 4 due to the decrease in use.

Spending by wilderness visitors at local stores, motels, and hotels, and other tourism-related businesses and attractions could be lower over time compared to the no-action alternative. The reduction in spending would affect recreation-oriented businesses in gateway communities serving as staging areas for self-guided overnight wilderness trips and trips supported by guides and outfitters. The decline in visitor use

and spending could also result in a reduction in jobs supported, but the net effects would likely be negligible to minor. The economic stimulus associated with wilderness use would remain highly seasonal. State and local governments could realize slightly lower revenues from visitor spending than under the no-action alternative, but the loss would be negligible in the context of the overall stimulus associated with the parks and the overall size and scale of the regional economy.

Wilderness use in the parks would not be a direct catalyst for regional population growth under alternative 4. Little change in park-related demands on community services and facilities across central California would result from implementing alternative 4. The influence of the parks' wilderness management on community attitudes and lifestyles would not alter dramatically under alternative 4.

No major changes in budgeted resources to fund park operations in wilderness would be anticipated under alternative 4. NPS maintenance staff would perform much of the work to address maintenance and preservation, restoration, and rehabilitation activities. Management actions to implement alternative 4 would be achieved through reprioritization and reallocation of existing funds. Implementation of alternative 4 may initially require more effort directed toward removal of facilities and subsequent rehabilitation actions. In the long term, reduction in maintenance at the removal sites would facilitate other management actions. The elimination of all grazing could necessitate increased helicopter use and expense.

A series of short-term increases in seasonal employment and spending would result if the parks successfully gain access to additional funds.

At the regional level, the socioeconomic effects related to park wilderness visitors and park operations under alternative 4 would be both adverse and beneficial.

**Cumulative Effects:** The social and economic effects from other projects would be the same under alternative 4 as under alternative 2. From the economic and social perspectives, the contributions of alternative 4 to the cumulative economic and social effects, including those associated with increased visitor and NPS operating expenditures, would be similar to those under the no-action and alternative 2. Impacts of alternative 4 would comprise a small portion of the overall cumulative social and economic effects.

## **IMPACTS OF ALTERNATIVE 5: EMPHASIZE OPPORTUNITIES FOR SOLITUDE**

Implementation of alternative 5 would occur against the same backdrop of economic, demographic, and social conditions across the region described under the no-action alternative (i.e., substantial population growth through 2040). Alternative 5 would add another set of influences, albeit virtually indiscernible, affecting the region's economic and social environment, but would leave the basic foundation of the area's economic and demographic outlook unchanged.

Wilderness management actions under alternative 5 would reduce overall wilderness visitation. The level of commercial use would decline long-term under alternative 5 due to the combination of reduced visitor use levels and reduced commercial services allotments wilderness-wide. These effects could reduce income for outfitters, adversely affecting the long-term economic viability of some outfitters, potentially to the point that one or more outfitters may choose to forego pursuit of CUAs. Such a decision could have indirect economic and social effects in community(ies) that serve as the base of operations for those outfitters, such as reduced demand for lodging and restaurant expenditures by clients before and after their trips. These in turn could adversely affect seasonal employment opportunities in those communities.



Due to the net long-term reduction in use expected under alternative 5, overall spending by wilderness users would decrease under alternative 5. Guides and outfitters, including stock and dunnage providers, could experience long-term revenue declines. These effects could reduce income for outfitters, adversely affecting the long-term economic viability of some outfitters, potentially to the point that one or more outfitters may choose to forego pursuit of CUAs.

Reductions in spending by wilderness visitors at local stores, motels, and hotels, and other tourism and recreation-related businesses would be concentrated in gateway communities serving as staging areas for self-guided overnight wilderness trips and trips supported by guides and outfitters. The decrease in spending could result in net reductions in jobs supported, but the net effects would likely be negligible to minor. The economic stimulus associated with wilderness use would remain highly seasonal. State and local governments could realize slightly lower revenues from visitor spending than under the no-action alternative, but the loss would be negligible.

Changes in wilderness use in the parks would not be a direct catalyst for regional population growth or decline under alternative 5. Little change in park-related demands on community services and facilities across central California would result from implementing alternative 5. The influence of the parks' wilderness management on community attitudes and lifestyles would not alter dramatically under alternative 5.

Implementing alternative 5 would contribute to the parks' sustained economic infusion to the region over the life of the WSP. The infusion would result from ongoing park operating expenditures, including staff payroll, one-time capital outlays, and environmental research and restoration projects associated with wilderness. The stimulus would be lower than under the no-action alternative and other action alternatives, but the differences would be negligible in the context of the overall stimulus associated with the parks and the overall size and scale of the regional economy.

No major changes in budgeted resources to fund park operations in wilderness would be anticipated under alternative 5. Management actions to implement the alternative would be achieved through reprioritization and reallocation of existing funds. Implementation of alternative 5 may initially require more effort directed toward removal of certain facilities and the rehabilitation of those areas. Over the long-term the reduction in maintenance at these sites could yield savings that might facilitate other management actions.

A series of short-term increases in seasonal employment and spending would result if the parks successfully gain access to additional funds.

At the regional level, the socioeconomic effects related to park wilderness visitors and park wilderness operations under alternative 5 would be both adverse and beneficial, in the short and long term.

**Cumulative Effects:** The social and economic effects from other projects would be the same under alternative 5 as under alternative 2. From the economic and social perspectives, the contributions of alternative 5 to the cumulative economic and social effects, including those associated with increased visitor and NPS operating expenditures, would be lower than those under the no-action and alternative 2. Impacts of alternative 5 would comprise a small portion of these overall cumulative social and economic effects.

## **CONCLUSION**

Visitor use in the parks, the associated spending, and the operations and maintenance of the parks by the NPS contribute to existing economic and social conditions in the region. It is estimated that visitor

spending supported about 1,817 jobs, with the annual operating budget at the park directly and indirectly supporting another 615 jobs in the region. Although substantial, those contributions represent a small portion of the overall regional economy.

The no-action and all action alternatives would sustain the economic infusions and social contributions of wilderness use in the regional economy. Any changes would be small in scale over the long-term, and would result in a combination of adverse and beneficial effects. As compared to current contributions, changes in future effects would generally be directly correlated to changes in the levels of wilderness use.

Alternatives that allow for increased visitor use, such as alternative 3, may therefore result in long-term increases in the economic and social benefits, and alternatives that reduce visitor use such as alternative 5, may result in limited reductions in economic and social benefits. Some individual outfitters and guides could be affected by changes associated with specific alternatives. For example, the effects of alternatives 4 and 5 could reduce income for outfitters, adversely affecting the long-term economic viability of some outfitters, potentially to the point that one or more outfitters may choose to forego pursuit of CUAs. Such a decision could have indirect effects in one or more gateway communities. However, the magnitude, type, and scale of either the adverse or beneficial effects anticipated from any of the WSP/DEIS alternatives would not be significant on a regional scale.

## **VISITOR USE**

Visitor experience is personal and difficult to quantify. What may detract from one person's experience may enhance or not affect the experience of others. In an effort to quantify differences between the alternatives, survey results from permitted overnight users presented in chapter 3 are used where appropriate to discuss potential changes to overall use and experience.

## **METHODOLOGY FOR ANALYZING IMPACTS**

Visitor experience can be affected by the types of activities, access opportunities and convenience, visitor restrictions, the number and types of administrative and visitor-related facilities, the condition of wilderness (e.g., campsite conditions), and the opportunity to experience wilderness using a commercial service provider.

Each alternative was examined to determine its effect on the visitor's use of wilderness, and their ability to experience the parks' wilderness. Public input and field staff observations of visitation patterns, combined with an assessment of current visitor use of wilderness, were used to estimate the relative effects of each of the alternatives. Impacts on visitor use and experience in the parks' wilderness were evaluated by identifying projected increases or decreases in access and other visitor uses under each alternative and determining how these projected changes would affect visitor experience, to what degree, and for how long. The analysis was also based on whether there would be a change in access or experience, or a change in perception of wilderness management and condition. Note that effects on solitude or opportunities for primitive or unconfined recreation are analyzed in the "Wilderness Character" section in this chapter.

## **TYPES OF IMPACTS ON VISITOR USE**

**Visitor Encounters:** The type and number of encounters a visitor has on their trip can affect their experience. Under each alternative, a variety of group types would continue to be allowed. Permit requirements and trailhead quotas help manage the number of visitors encountered to optimize visitor use and experience. The quota system establishes a cap for overnight visitors during peak months (May through September) and this time period accounts for the majority of visitors to the parks' wilderness. None of the alternatives would extend or reduce the quota period, and no change to the seasonal nature of

overnight visitation is expected to occur. The effect of visitor encounters on opportunities for solitude or primitive and unconfined recreation was discussed in the “Wilderness Character” section in this chapter; therefore this topic will not be further discussed.

**Visitor Access:** Visitor access would be modified in several ways under the alternatives. Reducing trailhead quotas could limit the number of permits available for certain areas of wilderness, while increasing quotas could result in improved access opportunities by increasing the number of permits available. These actions could result in visitors selecting alternative entry points from their desired destination. The implementation of day-use permits could result in reduced access for day hikers and riders. Day users may also change their entry point due to permit limitations and requirements, and may not be able to visit their desired destination.

The level of trail development could alter visitor access. Generally, more developed trails provide easier access into wilderness. However, some wilderness visitors prefer the lowest level of development so they can have a more adventurous wilderness experience. Abandoning currently maintained trails could limit access to wilderness for some users; however, under all alternatives, visitors would continue to have a variety of options for on-trail and off-trail wilderness use. Some alternatives also involve changes to the locations where visitors are permitted to travel or camp with stock.

Seasonality and trip length would not be affected by the alternatives. It is likely that overnight visitation would remain seasonal in nature under all of the alternatives; therefore this topic will not be further discussed.

**Visitor Restrictions:** Visitors value independence and spontaneity in wilderness, and rules and restrictions that reduce independence and spontaneity affect visitor use and experience. Restrictions on party size, campfire use, food storage, and management of human-waste can affect visitor experience and vary across alternatives, and are therefore further discussed below.

Visitor restrictions related to length of overnight stay would also vary across the alternatives. However, as stated in chapter 3, the majority of overnight visitors (80%) spend seven consecutive nights or less in wilderness (Martin and Blackwell 2013). None of the alternatives impose a restriction lower than this limit, and limits on overall trips would remain close to the current level. Alternative 3 proposes the greatest limit on length of stay with 7 nights at one location and 20 nights per trip in wilderness. Changing to a 20-night limit would affect an estimated 1.1% of wilderness users; close to 99% of visitors would not be affected. Because changes to maximum trip length affect very few visitors under any of the alternatives, this topic will not be further analyzed. Party size limits on- and off-trail vary by alternatives and can affect visitor use and experience. Therefore this topic will be further evaluated.

**Visitor Use and Freedom:** Where people can camp can affect the visitors’ overall experience. All of the alternatives establish the first allowable camp area. Generally, first-camp limits do not vary among the alternatives. However, the alternatives do consider a few exceptions to allow close-in camping. Allowing camping in close-in areas would result in a beneficial effect on user groups that may not be able to access points farther in wilderness, but could adversely affect those visitors who are day hiking in those areas.

Promoting the use of established campsites (i.e., previously disturbed areas) is common to all alternatives. Some alternatives would include designated campsites, some would add designated sites in popular areas, while some alternatives would eliminate designated campsites, and control use through other methods (e.g., trailhead quotas or destination permits). The visitor experience and use is influenced by requirements to camp in designated sites. This topic relates to the opportunities for primitive and unconfined recreation and was discussed in the “Wilderness Character” section in this chapter.

**Condition of Wilderness:** The wilderness-wide improvement in campsite conditions over the past 30 years has been attributed to increased regulation of visitor use, the extensive adoption of minimum-impact techniques by visitors, and increased restoration of areas impacted by campfires and visitor use. All of the alternatives would strive to maintain or improve campsite conditions to improve the visitor experience in wilderness.

Meadows and their surroundings are often perceived as a focal point of the wilderness experience and frequently serve as principal destinations for wilderness travelers. For those who ride and/or pack into wilderness, these areas also provide forage for stock. The popularity of meadows remained fairly constant from 1992 to 2012; stock groups repeatedly use the same meadows and campsites year to year. The availability of meadows for grazing, and the availability of non-grazed meadows, affects visitor use and experience. Under all action alternatives but alternative 4, grazing would be allowed, and opportunities to view and experience ungrazed meadows are also a component of all action alternatives.

**Activities:** Under all of the alternatives, visitors would continue to have the opportunity to experience a variety of recreational activities consistent with the Wilderness Act. All action alternatives allow for the continuation of these types of activities; therefore, this topic will not be further discussed.

**Administrative Developments and Facilities:** Under all alternatives, there would be facilities in wilderness to allow for the administration of wilderness. Facilities can attract visitors and provide solace and comfort. The facilities and rangers stationed in the wilderness can also provide information and assist wilderness visitors in many ways. While facilities in wilderness can reduce impacts on resources and enhance some users experience, they also can also concentrate use and adversely affect some visitors' experiences. Since there would continue to be facilities in wilderness under all alternatives, the effects across alternatives are not perceptible, and the effects of facilities on wilderness character were discussed in the "Wilderness Character" section in this chapter, this topic will not be further discussed.

**Visitor-related Facilities:** The alternatives allow for different types and numbers of facilities to manage wilderness visitors use and protect resources, including food-storage boxes and privies, and stock-related structures (fences/gates and hitch rails). These facilities are considered a convenience by some visitors and off-putting for other visitors, and thus will be further analyzed.

**Availability of Commercial Services:** Commercial services can facilitate visitor access to wilderness for those individuals who may not be prepared to engage in a specific activity without the support of an experienced professional. Commercially operated facilities in wilderness, such as the Bearpaw Meadow High Sierra Camp and the Pear Lake Ski Hut (currently operated under a cooperative agreement) are destinations for some visitors and can result in a beneficial effect on visitor use and experience. However, these facilities can adversely affect some visitors who believe they are inappropriate in wilderness.

## **IMPACTS OF ALTERNATIVE 1: NO-ACTION / STATUS QUO**

**Visitor Access:** Under the no-action alternative, there would be no change to the permitting system and no adjustment to trailhead quotas. There would continue to be no day-use permit or day-use quota system. The trail system and level of trail development would not change under this alternative. Therefore, under the no-action alternative, visitor use and experience would not change from current conditions.

**Visitor Restrictions:** There would be no additional limits imposed on campfires. Food-storage and human-waste requirements would not change. Party size limits for all groups on- and off-trail would not change. Therefore, under the no-action alternative, visitor use and experience would not change from current conditions.

**Condition of Wilderness:** The campsite conditions would be expected to remain stable. Meadows would continue to be a focal point for both stock and non-stock overnight users. Visitors who wish to experience ungrazed meadows would have the ability to view these resources but they may have to alter their travel plans to do so. Under the no-action alternative, visitor use and experience would not change from current conditions.

**Visitor-related Facilities:** There would be no change in the number or locations for food-storage boxes, restrooms and privies, and stock-related facilities. Under the no-action alternative, visitor use and experience would not change from current conditions.

**Availability of Commercial Services:** The parks issue about 32 commercial use authorizations annually. Approximately 6.5% of wilderness visitors take advantage of guide services to facilitate their wilderness experience for a variety of reasons. The commercial operation of the Bearpaw Meadow High Sierra Camp and the winter use of the Pear Lake Ski Hut would continue, resulting in both adverse and beneficial effects on visitor use and experience, depending on the visitor's expectations. Under the no-action alternative, park staff would conduct a specialized Wilderness Act finding to determine the "extent necessary" for commercial services in wilderness.

**Cumulative Effects:** There are several past, present, and foreseeable future projects in the parks' wilderness and nearby USFS administrated lands that affect visitor use and experience. These are separate from projects proposed by this WSP/DEIS and include resource management and science, fire management, maintenance of the communication system, ongoing and future management plans, and area transportation projects.

Resource management and science actions may affect visitor use and experience through temporary closures, the placement of installations, increased encounters with park staff, and stock and helicopter use. Current and future projects include permitted research activities, soils mapping, forest monitoring, lake sampling, air quality monitoring, snow surveys, mountain yellow-legged frog restoration activities, Sierra Nevada bighorn sheep recovery actions, bear management actions, invasive species eradication, meadows restorations projects, and others determined necessary to promote the natural quality of wilderness character.

While the purpose of these projects is to gather knowledge and restore the area to natural conditions, visitors may not wish to see these activities in wilderness, and may be adversely affected by temporary closures, viewing tagged or collared animals, seeing installations, hearing or seeing helicopters, having reduced opportunities for fishing (from aquatic ecosystems restoration program), or experiencing invasive species eradication actions. However, some visitors may benefit from the opportunities to experience these actions as they would learn more about wilderness resource management and restoration activities.

The Sequoia and Kings Canyon National Park fire management program, along with the fire management program of adjacent U.S. Forest Service administered lands, may affect the wilderness visitor use and experience. The area fire programs allow, under certain conditions, natural fires to burn in wilderness. This could result in area and trail closures, reduced visibility due to smoke, and impacts on visitor health from smoke, which would affect visitor use and experience. Some visitors would change their itineraries to avoid the fire-affected areas. However, in the long-term areas would be restored to a more natural fire regime, and this would result in wilderness ecosystem less manipulated by fire suppression activities as well as a reduced risk of extreme fire behavior that could result in a larger closure, and diminished wilderness conditions.

The maintenance of the existing communication network (radio repeaters) in the parks places equipment in wilderness; however, the communication network allows rangers and other park staff to communicate

emergencies to search and rescue teams. Installations in wilderness diminish visitor experience, however, they aid in emergencies, so there are both beneficial and adverse effects on visitor use and experience.

Management plans that could affect visitor use within the parks' wilderness, or in the region, include the Sequoia and Kings Canyon Cave Management Plan which would address recreational access to the parks caves; USFS wilderness plans for the John Muir, Golden Trout, and Monarch wilderness areas; the USFS forest plan amendments for the Sierra, Inyo, and Sequoia national forests and Giant Sequoia National Monument (adjacent wilderness areas); and the Yosemite Wilderness Stewardship Plan (future). The USFS wilderness plans established restrictions on visitor use, including trailhead quota limits, caps on commercial services, and exit quota limits on Mount Whitney. The ongoing planning efforts would include a recreational use component to balance resource protection mandates with visitor enjoyment. These plans would enhance visitor experience through preservation of natural conditions, while affecting some visitor activities through the implementation of additional restrictions or regulations.

In addition, some ongoing and future implementation plans and projects specifically address visitor use and experience in wilderness. The Concessions Prospectus (ongoing) for Sequoia National Park will address the operation of Bearpaw Meadow High Sierra Camp. Whether this operation is allowed to continue in the future will be directly linked to this WSP. The Mineral King Management Plan (ongoing) would determine what facilities are necessary in the Mineral King area with the goal of supporting continued wilderness access. The Lodgepole area (including Wolverton and Wuksachi) plan (future) is a comprehensive visitor service and facilities plan to improve visitor services and could affect access to wilderness. The USFS stock use management program (on-going) establishes the party size, access, and commercial use of stock in USFS managed lands.

The present Generals Highway Project to rehabilitate the Generals Highway and the Sequoia National Park Transit System (on-going) are in the frontcountry and can affect wilderness access. The Generals Highway Project may require periodic lane closures and vehicular delays resulting in no early-morning access to some trailheads. The current transit system provides shuttle access to the Lodgepole Visitor Center, Wuksachi, Dorst Creek Campground, Wolverton, and Crescent Meadow, and provides visitors with transportation to wilderness entry points.

Since this alternative proposes no changes to the management of wilderness, except for the determination of the proper levels and types of commercial services, there would be no significant cumulative impacts on visitor use and experience associated with the alternative.

## **IMPACTS OF ALTERNATIVE 2: PROTECT WILDERNESS CHARACTER BY IMPLEMENTING SITE-SPECIFIC ACTIONS (NPS PREFERRED ALTERNATIVE)**

**Visitor Access:** Trailhead quotas would remain at their existing levels, approximately; but there could be a reduction in quotas in busy areas. Existing destination quotas would continue to be applied and additional destination quotas may be added for specific areas. A reduction in trailhead quotas in busy areas, and the application of additional destination quotas could impact some visitors wanting to visit these areas. Visitors may need to change their entry point, destination, or the day of the week they enter the wilderness. If day-use permits or quotas are implemented, visitors may decide not to utilize those trailheads, or may not be able to obtain a permit at the trailhead of their choice, resulting in an adverse effect on visitor use and experience.

Visitors would continue to have opportunities to travel on a maintained trail and in untrailed areas. There would be several trails designated as foot-only trails, allowing visitors the opportunity to travel in areas without the sign of stock use. Trails closed to all stock use would increase by approximately 30 miles.

This would have a minimal effect on the geographic distribution of stock users as most of these trails have not been frequently utilized by stock users.

**Visitor Restrictions:** Areas where visitors are allowed to have campfires would decrease under alternative 2 to 395,710 acres. Those visitors who wish to experience a campfire may adjust their camp locations below the elevation limits, resulting in an effect on the geographic distribution of visitors. Those visitors who do not wish to camp within the sight or smell of a campfire would have more areas to camp under this alternative where they would not be affected by campfires.

The requirement to store food in animal-resistant containers would remain similar to the no-action alternative. This requirement may be expanded into areas where there is a higher risk of human-bear interactions. This could result in an inconvenience to those visitors who need to carry additional food-storage containers.

Human-waste requirements, such as the requirement to carry out waste, could be expanded into new areas to minimize the need for restrooms and privies. This could cause an inconvenience to some visitors.

Camping in designated campsites or camp areas would continue to be required in four areas. Additional designated campsites may be established. Designated campsites may appeal to some visitors, but other visitors consider the establishment of designated sites an adverse effect on their wilderness experience and may choose to camp elsewhere due to this requirement.

On-trail party size would remain similar to alternative 1, with some reduction in the largest allowable stock-party sizes. Off-trail party sizes would be reduced for stock and foot parties. These additional limits would affect the largest parties (more than 12) traveling off-trail, which account for less than 1.3% of overnight visitors. Area specific party size limits of eight would be adopted in five areas of the park. Party size restrictions reduce the areas in which large groups are able to travel together in wilderness, resulting in adverse effects on the visitor experience and use of those groups. Reduced party sizes, however, result in an improved visitor experience for visitors who wish to view fewer people in wilderness.

**Condition of Wilderness:** Campsite conditions would continue to improve as a result of restoration actions, removal of campfire rings in campfire-prohibited areas, decreases to night and group size limits, and the removal of facilities from certain locations.

Some additional meadows would be closed to grazing. Stock users may choose to visit a different location to graze, while hikers may be attracted to meadows where grazing is prohibited. Visitors who wish to view ungrazed meadows would have more opportunities, as compared with alternative 1, and this could improve their visitor experience.

**Visitor-related Facilities:** Forty-eight food-storage boxes would be retained in the most popular areas of the parks, 26 would be removed, and 13 would be considered for removal. Visitors tend to use food-storage boxes where they are available; for other visitors they detract from the wilderness experience. Alternative 2 would result in the removal of some privies. For some visitors, the privies and toilets enhance their recreational experience by providing a desired convenience; for others, they detract from the wilderness experience by reducing wilderness' primitive quality. Thus, their removal would result in adverse effects on some visitors' experiences and beneficial effects on other visitors' experiences. Grazing-related structures in wilderness would be reduced. This would adversely affect some stock users who rely on those facilities to confine their stock, but stock visitors could still use and experience these areas by using alternative methods of confinement.

Visitors that have expectations of using these facilities would benefit where these facilities remain and would be adversely affected in areas where these facilities are removed. Visitors who do not wish to have these facilities in wilderness would continue to be adversely affected, but there would be a slight benefit to these visitors from the reduction of the number of facilities overall.

**Availability of Commercial Services:** Per the specialized Wilderness Act finding to determine the “extent necessary” for commercial services in wilderness, commercial services would continue to be allowed under alternative 2. This availability of commercial support would be of particular benefit to those visitors that wished to engage in a stock-supported trip, and to visitors that wished to have introductory or educational experiences in wilderness travel or in particular wilderness activities. However, the levels and types of commercial services authorized in the Mount Whitney Management Area would be reduced with the intent to improve natural and social conditions in that area, which would improve the visitor experience overall. However, those visitors who wish to access Mount Whitney with a commercial service provider may not be able to do so on the day, or year, of their choice if commercial service allocations are at capacity.

The commercial operation of the Bearpaw Meadow High Sierra Camp and the winter use of the Pear Lake Ski Hut would continue to be authorized, resulting in both adverse and beneficial effects on visitor use and experience depending on their expectations.

**Cumulative Effects:** As stated under alternative 1, visitor use and experience have been affected by past and present actions, such as resource management and science projects, the NPS and USFS fire management program, the administration of the existing communications network within the parks, and the implementation of rules, regulations, and visitor-use restrictions in the parks and on adjacent USFS wilderness areas. In addition, visitors can be affected by frontcountry activities that enhance or restrict access, such as the Generals Highway rehabilitation project (past, present, and future) and the existence of a transit system within Sequoia National Park.

The cumulative impacts of this alternative relate primarily to restrictions in access for commercial service providers. Past wilderness management plans for the adjacent USFS areas have already restricted commercial use in Inyo National Forest wilderness. Further restrictions imposed under this alternative in the Whitney Management Area could result in fewer opportunities for some visitors to use commercial service providers to access the parks’ wilderness in this area. However, there would still be ample opportunities to use commercial services in other areas of wilderness.

This alternative would result in localized adverse and beneficial effects in the most popular areas. Considered together there would be no meaningful additive or interactive effects between these projects and the proposed actions under this alternative that would constitute a significant cumulative effect on visitors.

### **IMPACTS OF ALTERNATIVE 3: PROVIDE MORE OPPORTUNITIES FOR PRIMITIVE RECREATION**

**Visitor Access:** Trailhead quotas would increase at trailheads that currently fill during peak season. Other trailhead quotas would remain the same. Existing destination quotas would continue to be applied and no additional destination quotas would be implemented. It is likely that increases in popular trailhead quotas would result in increased visitor use in those areas. This could benefit visitors who wish to use these trailheads. Other visitors may adjust where and when they enter wilderness to avoid the busiest trailheads or time periods. No day-use permit or day-use quota system would be implemented; therefore, there would be no impacts on day users from the implementation of a permit system.



Compared to the no-action alternative, there would be an additional 59 miles of maintained trails. Since the majority of visitors use trails, the additional miles of maintained trails would allow visitors more options for on-trail travel. There would be no additional limits on hikers going off-trail. This would allow hikers to disperse, although it is likely to have a minimal effect on the geographic distribution of hikers.

Trails closed to all stock use would increase by approximately 27 miles, and maintained trails open to overnight use by stock would decrease by about 21 miles. Stock would continue to be allowed off-trail. There would be little effect on stock users' geographic distribution from current conditions, but some stock visitors would be adversely affected by the decreased access opportunities.

**Visitor Restrictions:** Areas where visitors are allowed to have campfires would decrease under alternative 3 to 293,840 acres. Those visitors who wish to experience a campfire may adjust their camp locations below the elevation limits, resulting in an effect on the geographic distribution of visitors. Those visitors who do not wish to camp within the sight or smell of a campfire would have more areas to camp under this alternative where they would not be affected by campfires.

The requirements to store food in animal-resistant containers would remain similar to the no-action alternative; however, additional food-storage boxes could be placed in the wilderness. These would allow for visitor storage of food, and reduce the need to carry additional food-storage containers.

Human-waste requirements would be the same as alternative 1.

Similar to alternative 2, camping in designated campsites or camp areas would continue to be required in four areas. Additional designated sites could be established. Designated campsites may appeal to some visitors, but some visitors consider the establishment of designated sites as an adverse effect on their wilderness experience, and may choose to camp elsewhere due to this requirement.

On- and off-trail party sizes would remain the same for hikers, and would increase for stock users. Increased party size would benefit some visitors by allowing larger groups to travel in more areas. Increased party sizes could, however, result in adverse effects on the visitor experience for visitors who wish to view fewer people in wilderness.

**Condition of Wilderness:** Campsite conditions would continue to improve as a result of restoration actions and the removal of campfire rings in campfire-prohibited areas. However, there could be adverse effects on campsite conditions where additional food-storage boxes and privies are constructed as a result of increased use in these areas.

Some additional meadows would be closed to grazing. Grazing would generally be prohibited in areas open to off-trail use by stock, with some exceptions. Stock users may choose to visit a different location to graze, or choose to carry in feed, while hikers may be attracted to meadows where grazing is prohibited. Visitors who wish to view ungrazed meadows would have more opportunities when compared with alternative 1, and this could improve their visitor experience.

**Visitor-related Facilities:** All food-storage boxes would be retained and up to 35 additional boxes may be installed. Some campers congregate around food-storage boxes, making campsites more noticeable; resulting in a less natural condition and thereby diminishing visitor experience. However, some visitors use food-storage boxes where they are available and this enhances their visitor experience. Additional privies may be added in more popular areas to address increased visitor use.

Grazing-related structures in wilderness would be reduced. This would adversely affect some stock users who rely on those facilities to confine their stock, but stock visitors still could use and experience these

areas by using alternative methods of confinement. Removing all stock facilities would improve the visitor experience for those visitors who do not wish to see those types of facilities in wilderness.

Visitors that have expectations of using these facilities would benefit where these facilities remain and would be adversely affected in areas where these facilities are removed. Visitors who do not wish to have these facilities in wilderness would continue to be adversely affected, but there would be a slight benefit to these visitors from the reduction of the number of facilities overall.

**Availability of Commercial Services:** Per the specialized Wilderness Act finding to determine the “extent necessary” for commercial services in wilderness, commercial services would continue to be allowed under this alternative. This availability of commercial support would be of particular benefit to those visitors that wished to engage in a stock-supported trip, and to visitors that wished to have introductory or educational experiences in wilderness travel or in particular wilderness activities. The levels and types of commercial services authorized in the Mount Whitney Management Area would be reduced with the intent to improve the natural and social conditions in that area, improving the visitor experience overall. However, those visitors who wish to access Mount Whitney with a commercial service provider may not be able to do so on the day, or year, of their choice if commercial service allocations are at capacity.

The commercial operation of the Bearpaw Meadow High Sierra Camp and the winter use of the Pear Lake Ski Hut would continue, resulting in both adverse and beneficial effects on visitor use and experience, depending on their expectations.

**Cumulative Effects:** As stated under alternative 1, visitor use and experience have been affected by past and present actions, such as resource management and science projects, the NPS and USFS fire management program, the administration of the existing communications network within the parks, and the implementation of rules, regulations, and visitor-use restrictions in the parks and on adjacent USFS wilderness areas. In addition, visitors can be affected by frontcountry activities that enhance or restrict access, such as the Generals Highway rehabilitation project (past, present, and future) and the existence of a transit system within Sequoia National Park.

The cumulative impacts of this alternative relate primarily to restrictions in access for commercial service providers. Past wilderness management plans for the adjacent USFS areas have already restricted commercial use in Inyo National Forest wilderness. Further restrictions imposed under this alternative in the Whitney Management Area could result in fewer opportunities for some visitors to use commercial service providers to access the parks’ wilderness in this area. However, there would still be ample opportunities to use commercial services in other areas of wilderness.

This alternative would result in localized adverse and beneficial effects in the most popular areas. Considered together there would be no meaningful additive or interactive effects between these projects and the proposed actions under this alternative that would constitute a significant cumulative effect on visitors.

#### **IMPACTS OF ALTERNATIVE 4: EMPHASIZE UNDEVELOPED QUALITY AND NON-COMMERCIAL RECREATION**

**Visitor Access:** Trailhead quotas would remain the same or be slightly reduced, resulting in visitor use that would be the same as under the no-action alternative in most areas. Existing destination quotas would continue to be applied and additional destination quotas may be implemented at popular areas. If day-use permits or quotas are implemented, visitors may decide not to utilize those trailheads, or may not be able to obtain a permit at the trailhead of their choice, resulting in an adverse effect on visitor use. There also

could be a change in use patterns as visitors who cannot obtain a permit would be redirected to another trailhead.

Compared to the no-action alternative, maintained trails would decrease by about 10 miles. This is not a substantial decrease in maintained trails and thus is not expected to influence the spatial distribution of visitor use in wilderness.

Trails closed to all stock use, and those closed to overnight stock use, would increase under this alternative. Private stock parties would be allowed to travel in four off-trail areas, but commercial stock would not be allowed off-trail; however, few commercial parties currently travel off-trail based on stock use and grazing reports, and private use by stock parties is low. This alternative would not result in a substantial effect on the geographic distribution of stock users.

**Visitor Restrictions:** There would be no campfires allowed in wilderness. Those visitors who wish to experience a campfire in wilderness would no longer be able to do so, resulting in a diminished wilderness experience for them. Those visitors who do not wish to camp within the sight or smell of a campfire would be able to camp anywhere in the wilderness without being affected by campfires.

All overnight visitors would be required to carry portable animal proof containers to keep wildlife from accessing food or scented objects. Those visitors who relied on food-storage boxes for storing food would no longer be able to do so. Some visitors would adjust their wilderness visit based on this requirement, but as other adjacent wildernesses have container requirements, there should be little effect on the visitor use and experience. The removal of food-storage boxes could result in increased human-wildlife interactions, and wildlife obtaining human food. Visitors could lose their food to wildlife, resulting in an adverse effect on their experience. Also, if more wildlife management actions are needed as a result of wildlife becoming habituated or food-conditioned, this could result in an adverse effect on the visitor experience.

Cat-holes or pack-out waste kits would be required to manage human waste in wilderness. This may adversely affect the experience of those who use these facilities. In the highest use areas, removal of these facilities could result in adverse effects on a visitors' wilderness experience.

Party sizes would be reduced for hikers and stock users both on- and off-trail. These limits would affect on-trail groups of more than 12 people (which account for less than 1.3% of overnight visitors) and off-trail stock users with more than eight people in the party. Further area-specific restrictions would be implemented in Redwood Canyon. Party size restrictions reduce the areas in which large groups are able to travel together in wilderness, resulting in adverse effects on the visitor experience and use by those groups. Reduced party sizes, however, could improve the visitor experience of some users.

Grazing would be prohibited in wilderness. Since the number of stock per party would also be reduced, this may further limit where stock parties could travel due to the need to carry feed.

**Condition of Wilderness:** Campsite conditions would continue to improve as a result of restoration actions, removal of designated campsites, night limits, group size limits, and the removal of facilities. Prohibiting campfires wilderness-wide would improve campsite conditions because there would be no fire rings and a more natural setting for visitors to experience.

Visitors who wish to see ungrazed meadows would have more opportunities to do so under this alternative, as all grazing would be eliminated; this could improve their wilderness experience.

**Visitor-related Facilities:** All food-storage boxes and privies would be removed wilderness-wide. For some visitors, these facilities enhance their recreational experience by providing a desired convenience; for others, they detract from the wilderness experience by reducing wilderness' primitive quality. Thus, their removal would result in adverse effects on some visitors' experiences and beneficial effects on other visitors' experiences. All stock facilities not associated with administrative use would be removed. This would adversely affect some stock users who rely on those facilities to confine their stock, but stock visitors still could use and experience these areas through alternative methods of confinement. Removing all stock facilities would improve the visitor experience for those visitors who do not wish to see those types of facilities in wilderness.

**Availability of Commercial Services:** Per the specialized Wilderness Act finding to determine the “extent necessary” for commercial services in wilderness, commercial services would continue to be allowed under this alternative; however, they would be reduced to levels lower than those under the no-action alternative. This reduced availability of commercial support would have particularly adverse consequences for those visitors that wished to engage in a stock-supported trip, and to visitors that wished to have introductory or educational experiences in wilderness travel or in particular wilderness activities. Pear Lake Ski Hut would no longer be operated as a commercial service in the winter, and the Bearpaw Meadow High Sierra Camp would be removed. Many visitors who want to experience wilderness but who need additional support to do so may not be able to receive this support from commercial services.

**Cumulative Effects:** As explained in alternative 1, visitor use and experience have been affected by past and present actions, such as resource management and science projects, the NPS and USFS fire management program, administration of the existing communications network within the parks, and the implementation of rules, regulations, and visitor-use restrictions in the parks and on adjacent USFS wilderness areas. In addition, visitors can be affected by frontcountry activities that enhance or restrict access, such as the Generals Highway rehabilitation project (past, present, and future) and the existence of a transit system within Sequoia National Park.

The cumulative impacts of this alternative relate primarily to restrictions in access for commercial service providers. Past wilderness management plans for the adjacent USFS areas have already restricted commercial use in Inyo National Forest wilderness. Further restrictions imposed under this alternative wilderness-wide, with additional limits imposed in the Mount Whitney Management Area, would result in fewer opportunities for some visitors to use commercial service providers to access the parks' wilderness.

This alternative would result in localized adverse and beneficial effects in the most popular areas. Considered together there would be no meaningful additive or interactive effects between these projects and the proposed actions under this alternative that would constitute a significant cumulative effect on visitors.

## **IMPACTS OF ALTERNATIVE 5: EMPHASIZE OPPORTUNITIES FOR SOLITUDE**

**Visitor Access:** Trailhead quotas would be notably reduced from current levels. Existing destination quotas would be discontinued; however, new destination quotas and day-use permits for popular destinations could be implemented in the future. With a reduction in trailhead quotas, visitors who failed to obtain a permit would be redirected to another, less-preferred trailhead, or choose to forego their trip in the parks' wilderness, resulting in an adverse effect on visitor use and experience.

Most trails would be maintained to their current class so that the broadest diversity of visitors can use them to seek solitude. A few trails would be designated foot-only trails where there are known threats to sensitive resources. Since the majority of visitors use trails that would be maintained in a similar

condition to their current class, there would likely be little influence on user destinations and travel in wilderness.

The number of trails closed to all stock use, and those closed to overnight stock use, would increase under this alternative, and all stock parties would be prohibited from traveling off-trail. Based on stock use and grazing reports, very few stock parties travel off trail. However, this prohibition still could have an effect on the geographic distribution of stock users concentrating them to trails open to stock use.

**Visitor Restrictions:** Areas where visitors are allowed to have campfires would increase under alternative 5 to 425,276 acres. Those visitors who wish to experience a campfire could use a larger area of wilderness, resulting in an effect on the geographic distribution of visitors. Those visitors who do not wish to camp within the sight or smell of a campfire would have fewer areas to camp under this alternative where they would not be affected by campfires.

This alternative would be similar to alternative 4 in that all food-storage boxes would be removed; however, under alternative 5 visitors have the option to provide a self-determined method to keep wildlife from accessing food or scented objects. The impacts would be the same as described for alternative 4: some visitors would adjust their wilderness visit based on this requirement, there could be an increase in human-wildlife interactions, and visitors could lose their food to wildlife.

Since all privies would be removed, cat-holes, or pack-out waste kits where cat-holes are not feasible, would be required to manage human waste in wilderness. This may adversely affect the experience of those who use these facilities. In the highest use areas, removal of these facilities could result in adverse effects on a visitors' wilderness experience.

On- and off-trail party size limits would be reduced for hikers and stock groups. Based on current hiker- and stock-party size, this would not affect the majority of users.

Grazing would no longer be allowed in off-trail areas closed to stock use, and some additional meadows would be closed to grazing. Since the number of stock per party would also be reduced, this may further limit where stock parties could travel due to the need to carry feed.

**Condition of Wilderness:** Campsite conditions would continue to improve as a result of restoration actions, removal of designated campsites, night limits, group size limits, and the removal of facilities. The increased area where campfires would be permitted could result in a decrease in campsite conditions.

Visitors who wish to see ungrazed meadows would have more opportunities to do so under this alternative, as grazing off-trail would be eliminated and some additional meadows would be closed to grazing near trails; this could improve their wilderness experience.

**Visitor-related Facilities:** All food-storage boxes and privies would be removed wilderness-wide. For some visitors, these facilities enhance their recreational experience by providing a desired convenience; for others, they detract from the wilderness experience by reducing wilderness' primitive quality. Thus, their removal would result in adverse effects on some visitors' experiences and beneficial effects on other visitors' experiences.

Grazing-related structures in wilderness would be reduced. This would adversely affect some stock users who rely on those facilities to confine their stock; but, stock visitors could still use and experience these areas with alternative methods of confinement. Visitors that have expectations of using these facilities would benefit where these facilities remain and would be adversely affected in areas where these facilities are removed. Visitors who do not wish to have these facilities in wilderness would continue to be

adversely affected, but there would be a slight benefit to these visitors from the reduction of the number of facilities overall.

**Availability of Commercial Services:** Per the specialized Wilderness Act finding to determine the “extent necessary” for commercial services in wilderness, commercial services would continue to be allowed under this alternative. However, the allocation of commercial support would be reduced to levels lower than those in the no-action alternative, in order to remain consistent with the overall reduction in visitor use under alternative 5. All visitors, including those that wished to engage in a stock-supported trip, and those that wished to have introductory or educational experiences in wilderness travel or in particular wilderness activities would have greater difficulty obtaining overnight permits for popular trailheads. Once an overnight permit was obtained, the ability to arrange for commercial support would be comparable to the no-action alternative. The Bearpaw Meadow High Sierra Camp would be reduced in size and the season of operation would be shortened. The Pear Lake Ski Hut would be converted to a non-commercial warming hut operated by the NPS. Visitors who want to experience wilderness but who need additional support to do so may not be able to receive this support from commercial services.

**Cumulative Effects:** As explained in alternative 1, visitor use and experience have been affected by past and present actions, such as resource management and science projects, the NPS and USFS fire management program, the administration of the existing communications network within the parks, and the implementation of rules, regulations, and visitor-use restrictions in the parks and on adjacent USFS wilderness areas. In addition, visitors can be affected by frontcountry activities that enhance or restrict access, such as the Generals Highway rehabilitation project (past, present, and future) and the existence of a transit system within Sequoia National Park.

The cumulative impacts of this alternative relate primarily to restrictions in access for commercial service providers. Past wilderness management plans for the adjacent USFS areas have already restricted commercial use in Inyo National Forest wilderness. Further restrictions imposed under this alternative wilderness-wide, with additional limits imposed in the Mount Whitney Management Area, would result in fewer opportunities for visitors to use commercial service providers to access the parks’ wilderness.

This alternative would result in localized adverse and beneficial effects in the most popular areas. Considered together there would be no meaningful additive or interactive effects between these projects and the proposed actions under this alternative that would constitute a significant cumulative effect on visitors.

## **CONCLUSION**

All alternatives allow for visitors to continue to use and experience the wilderness. The primary differences relate to access opportunities, visitor restrictions, the number and types of facilities, the wilderness condition, and the opportunity to experience wilderness using a commercial service provider.

Under alternative 1, visitors would continue to have opportunities to experience and use the wilderness. There would be no change to access opportunities, visitor restrictions, facilities, the condition of the wilderness, and commercial services.

Alternative 2 allows for continued access and use; however, in some popular areas visitor use could be affected by reduced trailhead quotas, destination quotas, or day-use quotas. Visitors would continue to have opportunities to experience the wilderness both on- and off-trail. Visitor restrictions would be slightly modified, and wilderness conditions would continue to improve in many areas. There would be fewer facilities. Visitors would continue to utilize commercial service providers to access most areas of the wilderness.

Alternative 3 could result in increased use wilderness-wide, improve the ease of access into wilderness, and add facilities that would either benefit or adversely affect the visitor experience depending on their expectations. There would be increased restrictions under alternative 3.

Alternative 4 would limit certain uses, eliminating grazing, campfires, and reducing commercial services. There would be a reduction in visitor-related facilities. Alternative 4 would result in an adverse visitor experience for those visitors wishing to use stock in wilderness because they would be required to carry in feed. Visitors wishing to view ungrazed meadows would benefit the most under this alternative. This alternative would result in decreased opportunities for visitors to use commercial service providers; however, visitors who wish to see reduced commercial services in wilderness would benefit under this alternative.

Alternative 5 results in the most change to the visitor use and experience resulting from the decreased access wilderness-wide. Fewer visitors would be able to access wilderness, which would result in beneficial effects for those visitors who gain access, but there would be adverse effects from reduced availability of wilderness permits. Stock would no longer be allowed to travel off-trail.

All of the alternatives have both adverse and beneficial effects on visitor use and experience, but overall impacts would not be significant.

## **PARK OPERATIONS**

This section evaluates the impacts on park operations from the alternatives, including the potential for changes to workload, staffing levels, funding, and management facilities.

### **METHODOLOGY FOR ANALYZING IMPACTS**

Impact analyses are based on the current description of wilderness-related park operations and infrastructure presented in chapter 3, and the ability to maintain the infrastructure used in the management of wilderness to adequately protect and preserve resources, and provide for an effective and safe employee environment and visitor experience. Resource-specific context for assessing impacts of the alternatives on park operations includes:

- the ability of the parks to operate within the constraints of the unit-specific budget and number of staff positions that have been allocated by congress and the NPS Director's office;
- the ability of park staff to provide for wilderness education, enforcement, and monitoring to protect wilderness character; and
- the ability of park staff to accomplish facility maintenance activities to protect wilderness resources.

### **IMPACTS COMMON TO ALL ALTERNATIVES**

The majority of the actions proposed in the WSP/DEIS would have little effect on park programs regardless of the alternative selected. The wilderness office would continue to be the principal public contact point for wilderness information and permit reservations. Wilderness and trailhead rangers would continue to patrol wilderness and provide education, enforcement, visitor assistance, and search and rescue. The Division of Interpretation, Education, and Partnerships would continue to play a large role in visitor perception, stewardship, and safety in wilderness. Resource management and science activities would continue to occur within wilderness. It is not anticipated that implementing any of the WSP/DEIS alternatives would have a measureable effect on the aforementioned programs.

The primary effects on park operations relate to changes in the permitting and quota system; the trails management program; the designation of campsites or the establishment of new camp areas; potential reductions or increases in wilderness management facilities; the management of stock use and related monitoring activities; changes in grazing restrictions; the management of commercial services in wilderness; modifications in frontcountry facilities; and, the implementation of the wilderness character monitoring program. The following section describes the effects that are generally common across all action alternatives.

Alternatives that would implement destination quotas and/or day-use permits would require increased levels of coordination between the wilderness office, trailhead staff, and wilderness rangers, along with additional information provided to the public about the new requirements.

There would be a change in the trails management program as a result of implementing the trails classification system. The general kind of activities undertaken would be the same under all alternatives, but the specifics would vary considerably. For instance, resources permitting, a Class 1 trail would be maintained only once every 3 to 4 years, a Class 2 trail would be maintained annually, and a Class 3 trail more than once a year. Each alternative calls for different class and design standards for specific trail segments. As these are often different from the existing conditions, each alternative would require a different list of construction and landscape restoration projects to transform the trail or trail segment from the existing condition into the desired condition. Also, cultural surveys would be required prior to establishing new trails or relocating trail segments. The changes would be implemented as funding allows, so realizing the desired conditions would take more or less time based on the alternative selected. Fully implementing the classification system for trails management would not be an undue burden on existing park operations.

The placement of new facilities or designation of campsites would result in new disturbed areas that would require cultural surveys to ensure no archeological resources would be affected. The effects will be discussed within the analyses of the alternatives below.

Reduced or increased facilities in wilderness would result in changes in park operations. This would vary across alternatives. Fewer ranger stations would result in changes in the patrol function. Moving ranger stations to more appropriate locations for the patrol function would result in improvements to the patrol functions. Removing ranger stations could result in fewer personnel stationed in wilderness, increasing the patrol areas for the remaining wilderness rangers. It also could result in more trailhead-based patrols, which could limit the areas of patrol. Removing the long-term crew camps would result in changes in the trail maintenance program. Relocating, removing, or adding facilities would result in increased compliance requirements. Since the effects vary across the alternatives, they will be discussed in the following sections.

The management of stock use and meadow monitoring is common across all alternatives except alternative 4. Under alternative 4, there would not be grazing, but there would still be monitoring associated with general stock use (e.g., impacts from holding and feeding). Annual monitoring by the program would continue to be accomplished in cooperation with the wilderness ranger staff; plant ecologists would continue to provide technical oversight and field consultation.

Changes in grazing restrictions under all action alternatives would require some initial work to update information provided to the public, and to educate the public and commercial service providers. However, under the existing wilderness program, restrictions are adjusted every year, as is the information provided to the public. Therefore, implementation of the action alternatives is not expected to affect the current wilderness information program.



Those park operations that utilize stock would be affected by changes in the grazing restrictions and the new feed requirements. The impact would vary across alternatives, and be particularly adverse under alternative 4 because no grazing would be allowed. There could be additional costs involved with limited grazing and the purchasing of feed; however, the parks have been phasing in the feed requirement for several years, and there would be little difference in the costs with running the stock program from the purchasing of allowable feed under alternatives 2, 3, and 5. The effects from alternative 4 will be discussed separately.

The management of commercial services under all of the action alternatives would affect the parks concessions management program, wilderness office, and data management program. There would be new reporting requirements from the commercial service providers and new data management demands for the parks to track and manage the allocations. Existing staff would have to be redirected to manage the program, or new staff would need to be hired.

Across all action alternatives there could be changes in park frontcountry facilities. This would require site-specific planning, design, and compliance, contracting, and project oversight. The planning would be implemented as funding allows, so realizing the desired conditions would take more or less time based on the alternative selected. In addition, since the areas considered are already developed, there would be no additional maintenance needs at most of the facilities, except for the alternatives related to stock use facilities. Facilities such as new pack stations and stock campsites would require additional monitoring and management oversight. Existing park staff would need to be redirected to support these facilities, or new staff would need to be hired.

There is an ongoing program to monitor aspects of wilderness character, including the natural quality, visitor encounters, and campsite conditions. The existing program would be slightly modified under all of the WSP/DEIS alternatives (appendix C) to allow managers to monitor and mitigate effects more proactively. The program would increase the staff time required to fully implement the program, increase the data management needs for the wilderness management program, and could result in increased staffing levels or a shift of duties of current staff to allow for full implementation.

## **IMPACTS OF ALTERNATIVE 1: NO-ACTION / STATUS QUO**

This alternative would continue the status quo per the BMP and SUMMP. There would be no change to park operations from current conditions.

**Cumulative Effects:** There are a number of past, present, and future foreseeable projects that have affected or may affect park operations. Past planning efforts, such as the GMP, established goals and objectives for overall parks management. Implementation plans are tiered to the GMP and require park staff time. Ongoing planning efforts, such as the high-elevation aquatics ecosystem restoration plan and frontcountry development plans may result in increased workload for park staff as plans are being prepared. As plans are completed, there are long-term implications; funding and staff may be redirected to support the implementation of the plans. The overall goal with all planning efforts is to have achievable results.

Other considerations include ongoing budget and staffing constraints. Past budget cuts have resulted in reduced staffing levels parks-wide. Some park projects have been postponed or cancelled due to budget and staff limitations.

Since this alternative proposed no changes to the management of wilderness, there would be no significant cumulative impacts on park operations associated with the alternative.

## **IMPACTS OF ALTERNATIVE 2: PROTECT WILDERNESS CHARACTER BY IMPLEMENTING SITE-SPECIFIC ACTIONS (NPS PREFERRED ALTERNATIVE)**

Additional destination quotas and day-use permits could be implemented under this alternative. This would require staff time to develop, implement, and manage the system. This would be accomplished by modifying existing staff priorities and/or hiring seasonal staff to assist with managing this program.

This alternative would modify the existing trails management program, but should not result in undue burdens on park operations. Most of the parks' trails are already designed and constructed to provide for appropriate access while preserving wilderness character. A few existing trail segments would be targeted for further development. Some "designated unmaintained routes" listed in the 1986 SUMMP would be designated as Class 1 trails and targeted for appropriate construction and maintenance. Other "designated unmaintained routes" would be abandoned and landscape restoration considered. All this work would be planned and implemented under existing funding strategies, including obtaining project-specific funding, with consideration of workload and staff. There would be no measurable effect on park operations.

The addition of designated campsites that could occur under this alternative would result in short-term effects on park operations as work is being planned and conducted. However, as stated previously, projects would be implemented as funding and workload allows, so there would be no undue burden on existing park operations. There would be a slight long-term adverse effect as more staff time would be required to manage the reservation program for areas with destination quotas.

Stock access and grazing restrictions would be modified under this alternative. The modifications would have no long-term effect on park operations. Administrative stock would continue to comply with the grazing restrictions. The pastures would remain under this alternative; therefore, there would be no effect on park operations from closing pastures. The new feed requirement would add cost to park stock operations; however, the parks have been phasing this in for several years, and thus fully complying with the requirement would not be an undue burden on park operations.

Most of the ranger stations and crew camps would remain in place under this alternative; locations could change for two stations. One administrative tent platform would be removed and converted to an administrative camp area. Some installations could be removed from administrative camps. The Redwood Canyon Cabin would be removed. During project planning and implementation there would be increased workload for park staff in the short-term; however, there would be no long-term effect on wilderness ranger and trail crew operations. There could be reduced research in the Redwood Canyon area due to the lack of a support facility in the area.

There could be short-term adverse effects during the removal of food-storage boxes and privies as crews would be diverted from other duties for project implementation. If new privies are constructed in close-in areas or at Rock Creek, the project planning, compliance, and implementation would occur as funding allows, and would not result in an undue burden on existing park operations.

Changes in the commercial services program would require park staff to modify use limits, establish use areas, and then allot the use and administer, monitor, and enforce the restrictions. This would result in an increased workload in the long-term for the concessions management office, wilderness office, and other staff to manage data to track use.

Wilderness character monitoring would continue under this alternative but could be modified by future planning efforts (see appendix C). Fully implementing the wilderness character monitoring program to track encounters, monitor campsite impacts, and other monitoring associated with this program would result in staff being redirected from other duties, and/or hiring additional seasonal staff or using

volunteers. This would result in an increased workload for wilderness rangers, trailhead staff, resource and wilderness office staff, and others to manage this program.

The concessions office, the wilderness office, and other staff, would be responsible for managing the commercial services program under all alternatives. Staff would need to be redirected or additional staff would be required to manage the permitting, reporting, and data management for this program.

Modifications to frontcountry facilities would require park staff involvement in site-specific planning, design, and compliance; contracting; project oversight; and maintenance and monitoring of the sites. As stated under “Impacts Common to all Alternatives,” these actions would be implemented as funding allows and would not result in an undue burden on existing park operations in the short term. However, if the pack station is reopened at Wolverton, the concessions office would be charged with managing an additional concessions contract, and park staff would be responsible for monitoring the facility to assure that permit conditions are being achieved. If campsites are added to the Cedar Grove pack station, and other campsites are converted to allow stock camping, these areas too would require additional management and monitoring to ensure the protection of park resources. This would require redirecting staff from other duties, or hiring additional seasonal staff (as these would be seasonal operations).

**Cumulative Effects:** As stated under alternative 1, there are a number of past, present, and future foreseeable projects that affect park operations. This WSP/DEIS was developed in consideration of these plans. After initial changes to the wilderness-related programs, this alternative would result in impacts that are not substantially different from the no-action alternative. There would be both adverse and beneficial effects. Considered together there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect on park operations.

### **IMPACTS OF ALTERNATIVE 3: PROVIDE MORE OPPORTUNITIES FOR PRIMITIVE RECREATION**

There would be increases in quotas for all trailheads, but this action would have no effect on park operations. There would be no additional destination quotas and no day-use permits implemented under this alternative. Therefore, this alternative would have fewer effects on the wilderness office than the other action alternatives.

Similar to alternative 2, this alternative would modify the existing trails management program. Alternative 3 would result in the most changes to the trails management program when compared with the other alternatives, as more trails would be designated as Class 3 trails, which require the highest amount of development and maintenance. However, as with the other alternatives, all work would be planned and implemented under existing funding strategies with consideration of workload and staff. Therefore, there would be no measurable effect on park operations.

The addition of designated campsites, along with the construction of associated facilities such as privies and the placement of additional food-storage boxes, would result in short-term effects on park operations as work is being planned and conducted. Projects would be implemented as funding and workload allows, so there would be no undue burden on existing park operations with the development of the sites. There would be a long-term adverse effect as more staff time would be required to manage the reservation program if destination quotas are implemented.

Stock access and grazing restrictions would be modified under this alternative. The modifications would have no long-term effect on park operations. Administrative stock would continue to comply with the grazing restrictions. The pastures would remain under this alternative; therefore, there would be no effect

on park operations from closing pastures. The new feed requirement would add cost to park stock operations; however, the parks have been phasing this in for several years and fully complying with the requirement would not be an undue burden on park operations.

All of the ranger stations and crew camps would remain in place under this alternative; six stations could be relocated to allow for more effective patrols. The relocation of the ranger stations and the establishment of new crew camps would require site-specific planning and compliance, adding to the existing workload of park staff in the short-term. In the long-term the relocation of ranger stations would lead to more a more effective patrol function. The additional crew camps would allow for a more effective trails management program. The Redwood Canyon Cabin would be retained, which could result in existing or expanded levels of research to continue in the area. This would also require the NPS to oversee this facility, potentially resulting in increased management and maintenance.

Changes in the commercial services program would require park staff to modify use limits, establish use areas, and then allot the use and administer, monitor, and enforce the restrictions. This would result in an increased workload in the long-term for the concessions management office, wilderness office, and other staff to manage data to track use.

Wilderness character monitoring would continue under this alternative. Fully implementing the wilderness character monitoring program to track encounters, monitor campsite impacts, and other monitoring associated with this program would result in staff being redirected from other duties, and/or hiring additional seasonal staff or using volunteers. This would result in an increased workload for wilderness rangers, trailhead staff, resource and wilderness office staff, and others to manage this program.

Modifications to frontcountry facilities would require park staff involvement in site-specific planning, design, and compliance; contracting; project oversight; and maintenance and monitoring of the sites. As stated under “Impacts Common to all Alternatives,” these actions would be implemented as funding allows and would not result in an undue burden on existing park operations in the short term. If commercial pack stations are reopened at Wolverton and Mineral King, the concessions office would be charged with managing additional concessions contracts, and park staff would be responsible for monitoring the facility to assure that permit conditions are being achieved. If public stock campsites are added to the pack stations, and other campsites are converted to allow stock camping, these areas too would require additional management and monitoring to ensure the protection of park resources. This would require redirecting staff from other duties, or hiring additional seasonal staff (as these would be seasonal operations).

**Cumulative Effects:** As stated under alternative 1, there are a number of past, present, and future foreseeable projects that affect park operations. This WSP/DEIS was developed in consideration of these plans. After initial changes to the wilderness-related programs, this alternative would result in impacts that are not substantially different from the no-action alternative. There would be both adverse and beneficial effects. Considered together there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect on park operations.

#### **IMPACTS OF ALTERNATIVE 4: EMPHASIZE UNDEVELOPED QUALITY AND NON-COMMERCIAL RECREATION**

As in alternative 2, additional destination quotas and day-use permits could be implemented under this alternative. There would be an overall reduction in trailhead quotas. This would require staff time to

develop, implement, manage, and communicate the changes to the public. This would be accomplished by modifying existing staff priorities and/or hiring seasonal staff to assist with managing this program.

This alternative would result in the lowest level of developed trails (fewer Class 3 trails than alternatives 2, 3, and 5). Some “designated unmaintained routes” listed in the 1986 SUMMP would be designated as Class 1 trails and targeted for appropriate construction and maintenance. Other “designated unmaintained routes” would be abandoned and landscape restoration considered. This alternative could also result in the removal of several trail bridges. All work would be planned and implemented under existing funding strategies with consideration of workload and staff; therefore, there would be no measurable effect on park operations.

The designated campsites would be removed under this alternative, and no new sites would be designated. This would result in reduced workload for park staff who oversee this program.

This alternative would modify the administrative stock program more than any other alternative. Due to the closure of wilderness to grazing, the administrative stock program would need to be modified greatly. No longer would the program be able to utilize meadows and pastures as staging areas for wilderness maintenance and ranger operations. All feed would need to be carried in by stock or by helicopter, if determined to be the minimum required for the administration of wilderness; this would add costs to the program and could result in a reduction in administrative use of stock.

This alternative would result in a change to the meadow management and monitoring program. Though grazing would not be allowed in wilderness, there would be new monitoring required at “hold and feed” areas to assure that unacceptable impacts are not occurring. Also there would be increased education and enforcement needed to implement the no grazing policy.

This alternative would result in the lowest level of development. There would be short-term effects on park operations due to increased workload during the project planning, compliance, and the implementation phase. The removal of historic structures would require additional compliance and planning, including the development of memorandums of understanding with the SHPO for actions resulting in adverse effects on cultural resources. Additional staff support may be needed to accomplish this work. Facilities would be removed, as funding and workload allows, so there would be no undue burden on existing park operations.

As facilities are removed, there would be decreased long-term maintenance required for their upkeep. There could be short-term adverse effects during removal operations as staff would be diverted from other duties, or additional staff would be hired to accomplish the removals. Certain facilities, such as ranger stations and crew camps, play an important role in wilderness management and protection. Without ranger stations and administrative camps, there would likely be a change in how the ranger patrols function. Fewer staff would be located in wilderness; instead they would be based out of the trailhead area, resulting in a decrease in ranger patrols. Without long-term trail crew camps, there would likely be reduced trail crew presence in wilderness and reduced levels of trail maintenance. Closing the pastures to administrative use would also affect the trails program, as they would not be able to base operations out of these pastures and would have to find new locations, and would be required to carry in all their feed.

The Redwood Canyon Cabin would be removed. During project planning and implementation there would be increased workload for park staff in the short term. There could be reduced research in the Redwood Canyon area due to the lack of a support facility in the area.

There could be short-term adverse effects during the removal of food-storage boxes and privies as crews would be diverted from other duties for project implementation. This would not result in an undue burden on existing park operations.

Wilderness character monitoring would continue under this alternative. Fully implementing the wilderness character monitoring program to track encounters, monitor campsite impacts, and other monitoring associated with this program would result in staff being redirected from other duties, and/or hiring additional seasonal staff or using volunteers. This would result in an increased workload for wilderness rangers, trailhead staff, resource and wilderness office staff, and others to manage this program.

This alternative would limit commercial services in the frontcountry and wilderness more than the other action alternatives. There would be no additional commercial services at Wolverton and Mineral King, and reduced services at Cedar Grove. The commercial use at the Pear Lake Ski Hut and the Bearpaw Meadow High Sierra Camp would be discontinued. Changes in the commercial services program would require park staff to modify contracts, use limits, establish use areas, and then allot the use and administer, monitor, and enforce the restrictions. This would result in an increased workload in the long-term for the concessions management office, wilderness office, and other staff to manage data to track use.

The alternative would result in the fewest modifications to frontcountry facilities, thus it has the smallest effect on park operations. As stated under “Impacts Common to all Alternatives,” any actions would be implemented as funding allows and would not result in an undue burden on existing park operations in the short term.

**Cumulative Effects:** As stated under alternative 1, there are a number of past, present, and future foreseeable projects that affect park operations. This WSP/DEIS was developed in consideration of these plans. This alternative would result in the most adverse impacts when considered with the other action alternatives. The adverse effects would relate to changes in the wilderness ranger function, trails management program, and administrative stock use program. After initial changes to the wilderness-related programs, this alternative would result in impacts that are not substantially different from the no-action alternative. There would be both adverse and beneficial effects. Considered together there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect on park operations.

## **IMPACTS OF ALTERNATIVE 5: EMPHASIZE OPPORTUNITIES FOR SOLITUDE**

Additional destination quotas and day-use permits could be implemented under this alternative. There would be an overall reduction in trailhead quotas. This would require staff time to develop, implement, manage and communicate the changes to the public. This would be accomplished by modifying existing staff priorities and/or hiring seasonal staff to assist with managing this program.

This alternative calls for most trails to be maintained at their current class, so there would not be undue burdens on park operations. Most of the parks’ trails are already designed and constructed to provide for appropriate access while preserving wilderness character. Some “designated unmaintained routes” listed in the 1986 SUMMP would be designated as Class 1 trails and targeted for appropriate construction and maintenance. Other “designated unmaintained routes” would be abandoned and landscape restoration considered. All this work would be planned and implemented under existing funding strategies with consideration of workload and staff. Therefore, there would be no measurable effect on park operations.

The designated campsites would be removed under this alternative, and no new sites would be designated. This would result in reduced workload for park staff who oversee this program.

Stock access and grazing restrictions would be modified under this alternative. The modifications would have no long-term effect on park operations. Administrative stock would continue to comply with the grazing restrictions. The new feed requirement would also add cost to park stock operations; however, the parks have been phasing this in for several years, and thus fully complying with the requirement would not be an undue burden on park operations.

This alternative would result in a reduced level of development. There would be short-term effects on park operations due to increased workload during the project planning, compliance, and the implementation phase. The preservation of historic structures under this alternative would result in fewer effects on park operations than alternative 4 due to reduced workload for the cultural resources program. Facilities would be removed as funding and workload allows so there would be no undue burden on existing park operations.

Four ranger stations would be removed under this alternative. All installations would be removed from administrative camps. There could be short-term adverse effects during removal operations, as staff would be diverted from other duties or additional staff would be hired to accomplish the removals. Certain facilities, such as ranger stations and crew camps, play an important role in wilderness management and protection. With fewer ranger stations and no administrative camps, there would likely be a change in how the ranger patrols function. Fewer staff would be located in wilderness; instead they would be based out of the trailhead area, resulting in a decrease in ranger patrols. Also, without long-term trail crew camps, there would likely be reduced trail crew presence in wilderness and reduced levels of trail maintenance. Most pastures would remain open to administrative stock use under this alternative but could be reduced in size; one pasture would be closed. Therefore, there would be a slight adverse effect on park operations from closing pastures.

The Redwood Canyon Cabin would be removed. During project planning and implementation there would be increased workload in the short term for park staff; however, there would be no long-term effect on wilderness ranger and trail crew operations. There could be reduced research in the Redwood Canyon area due to the lack of a support facility in the area.

There could be short-term adverse effects during the removal of food-storage boxes and privies as crews would be diverted from other duties for project implementation. This would not result in an undue burden on existing park operations.

Wilderness character monitoring would continue under this alternative. Fully implementing the wilderness character monitoring program to track encounters, monitor campsite impacts, and other monitoring associated with this program would result in staff being redirected from other duties, and/or hiring additional seasonal staff or using volunteers. This would result in an increased workload for wilderness rangers, trailhead staff, resource and wilderness office staff, and others to manage this program.

This alternative would result in approximately the same types of commercial services in the frontcountry and wilderness as currently exists. However, the changes in how the wilderness commercial services are managed would require park staff to modify permits, use limits, establish use areas, and then allot the use and administer, monitor, and enforce the restrictions. This would result in an increased workload in the long-term for the concessions management office, wilderness office, and other staff to manage data to track use.

Frontcountry facilities would be similar to current conditions, thus there would be no change to park operations.

**Cumulative Effects:** As stated under alternative 1, there are a number of past, present, and future foreseeable projects that affect park operations. This WSP/DEIS was developed in consideration of these plans. After initial changes to the wilderness-related programs, this alternative would result in impacts that are not substantially different from the no-action alternative. There would be both adverse and beneficial effects. Considered together there would be no meaningful additive or interactive effects among these projects and the proposed actions under this alternative that would constitute a significant cumulative effect on park operations.

## **CONCLUSION**

All of the action alternatives would result in both beneficial and adverse effects on park operations. The highest potential for adverse impacts on park operations would result from the lack of management facilities such as ranger stations and crew camps, and the inability to graze stock. All alternatives would result in limited adverse effects on park operations related to the wilderness character monitoring program and the additional requirements of the commercial services monitoring and database management program. Overall, impacts on park operations would not be significant.

## **SUSTAINABILITY AND LONG-TERM MANAGEMENT**

In accordance with NEPA and as further explained in Director's Order 12: *Conservation Planning, Environmental Impact Analysis, and Decision-making* (DO-12), consideration of long-term impacts and the effects of foreclosing future options should pervade any NEPA document. According to DO-12, and as defined by the World Commission on Environment and Development, "sustainable development is that which meets the needs of the present without compromising the ability of future generations to meet their needs." For each alternative considered in an EIS, considerations of sustainability must demonstrate the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity. This relationship is described below for each alternative.

The NPS must consider if the effects of the project alternatives involve tradeoffs in the long-term productivity and sustainability of the parks resources for the immediate short-term use of those resources. It must also consider if the effects of the alternatives are sustainable over the long term without causing adverse environmental effects for future generations (NEPA section 102(c)(iv)).

Under all of the alternatives, Sequoia and Kings Canyon National Parks would continue to be protected and would continue to be used by the public. The NPS would continue to manage the parks under all the alternatives to maintain ecological processes and native and biological communities, and to provide for appropriate recreational activities consistent with the preservation of wilderness character.

### **THE RELATIONSHIP BETWEEN SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY**

All of the alternatives would protect wilderness character in the long-term while providing recreational opportunities for wilderness visitors. Three types of wilderness use by visitors stand out as having the potential to create long-term losses of productivity of wilderness resources if improperly managed. These are camping use, firewood collection, and stock grazing. For each of these uses, the action alternatives propose management approaches that ensure that these uses occur sustainably, and that similar use by future generations is not jeopardized.



Camping use involves localized impacts to soils and vegetation, particularly in frequently used areas, that can result in long-term losses in productivity if camping impacts are not properly monitored and managed. Under all of the action alternatives there are limits placed on campsite condition that ensure that the amount of visitor camping use at particular locations does not exceed the capacity of that area to support camping use in the long term. Firewood collection, if conducted in excess of downed wood production, can result in a depletion of ground fuels. In some locations this downed wood is also a paleontological resource that, if destroyed, cannot be replaced within a meaningful time frame (i.e., some downed wood resources are thousands of years old). In order to ensure that firewood use is sustainable in the long term while protecting these important resources, all action alternatives propose either elevational limits on campfire use coupled with site-specific campfire closures, or ban campfires altogether (alternative 4). These approaches ensure that campfire use, where permitted, can be conducted sustainably.

Stock grazing is also managed so that this use can occur sustainably without long-term impacts to meadow resources. All of the action alternatives either limit the location, timing, and intensity of grazing by stock, or ban stock grazing altogether (alternative 4). Estimated grazing capacities for wilderness meadows have been developed using a model of biomass production and forage consumption that takes into account the elevation, soil moisture, and condition of the meadow. The capacity of individual meadows and uplands to sustain grazing would continue to be informed by each meadow's vulnerability to erosion or change in hydrologic function, susceptibility to invasion by nonnative plants, habitat requirements of sensitive plants and animals, productivity and the ability to sustain herbage removal, and the requirements of unique ecological communities such as peat-accumulating wetlands. These site-specific grazing capacities would be refined on an ongoing basis to protect resource integrity and to protect the natural quality of wilderness in the face of a changing climate.

The methodology for developing grazing capacities for all park meadows open for grazing is provided in appendix D.

**Adverse Impacts that Could Not be Avoided:** Even though stock grazing would be managed so that this use can occur sustainably without long-term impacts to meadow resources, where allowed, adverse grazing impacts on vegetation, soils, and wildlife would be measurable on a local scale, but would not be expected to result in significant, long-term changes in ecological structure, function, or composition at the landscape or population scale. Alternatives 2 and 5 would result in decreased impacts from trampling and grazing over those occurring under current conditions. Alternative 3 could produce slightly elevated impacts over current conditions. Alternative 4 would eliminate effects from trampling and grazing in meadows throughout the parks' wilderness.

The proposed stock management policies, including protection of natural processes, visitor education, and restrictions on amounts and extent of grazing and access, would continue to protect wetland and meadow systems throughout wilderness. The majority of wetlands and meadows would remain generally undisturbed, with localized exceptions associated with foot traffic and stock use along trail corridors and in those areas used for grazing. Although grazed meadows would be expected to exhibit some differences in productivity, cover, and composition relative to ungrazed meadows, these differences would not be expected to lead to significant long-term changes in productivity, structure or wetland function. Grazing would continue to be routinely monitored to ensure that impacts to vegetation were kept within acceptable levels, impacts to soils remained localized and would not lead to accelerated rates of erosion, and that new introductions of nonnative species were detected and responded to appropriately. The location, timing, and intensity of grazing would be managed to mitigate impacts on wildlife, ensuring that grazing did not result in significant adverse effects on wildlife populations.

A complete discussion of grazing and meadow management is contained in appendix D.

## **IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES**

The NPS must consider whether the effects of the alternatives are irreversible or irretrievable commitments of resources. Irreversible impacts are those effects that cannot be changed over the long term or are permanent. Irretrievable commitments are those resources that, once gone, cannot be replaced.

Several of the alternatives would involve the removal of historic structures that could not be replaced. Specifically, alternatives 2, 3, 4, and 5 would remove or replace the Bearpaw Meadow Ranger Station. Alternative 4 would also remove the entire Bearpaw Meadow High Sierra Camp, the Redwood Meadow Ranger Station, Simpson Meadow patrol cabin, and the Tyndall Ranger Station. While these actions would reduce development in wilderness, the loss of these historic structures would be permanent and an irretrievable commitment of park resources.

Concern has been expressed about the reversibility of impacts associated with stock grazing. Alternatives 1, 2, 3, and 5 would allow for the continuation of grazing by administrative and recreational stock. At very high grazing levels, such as those due to cattle and unrestricted saddle and pack stock grazing which occurred before the establishment of the parks, some meadows were irreversibly impacted due to the formation of deep gullies, destabilization of stream banks, the destruction of sods, and the intentional introduction of non-native forage species. However, the levels of use proposed under the alternatives that allow grazing are orders of magnitude below the levels that occurred before the establishment of the parks. Under all alternatives that permit grazing, impacts will be limited to a level that is reversible by the cessation of grazing. Under all alternatives, the management framework will ensure that stock use practices are modified if changes in the susceptibility to erosion, changes in hydrologic regimes, or other irreversible changes begin to occur. Continued monitoring of the system response to grazing will ensure that the use levels in the plan are meeting these standards.

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