NOXIOUS WEED RISK ASSESSMENT

Giant Sequoia National Monument Management Plan

Fresno, Tulare and Kern Counties
Sequoia National Forest
Giant Sequoia National Monument

PREPARED By: _____ DATE July 19th,2012

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Introduction

Invasive non-native species (or noxious weeds) are a growing problem in the Monument, as well as on adjacent lands and statewide. Noxious weeds are one of five major issues for the Sierra Nevada identified in the 2001 Sierra Nevada Forest Plan Amendment (2001 SNFPA). The 2001 SNFPA and other sources provide more detail on the extent and process of noxious weed invasions than the summarized version provided here. State or federal law classifies noxious weeds as undesirable, noxious, harmful, injurious, or poisonous. They generally have one or more of the following characteristics: aggressive and difficult to manage, poisonous, toxic, parasitic, carrier or host of serious insects or disease, and generally non-native.

Invasive nonnative species generally lack the competition and natural mechanisms that limit native plant populations, making them difficult to control and often resulting in their out-competing native plants. The results are loss of resource value and diversity. Not all non-native plants are highly invasive or considered noxious. Invasive non-native species are considered so widespread that eradication and most treatments are not practical. These species include cheat grass, black mustard, mullein, and tocaolote. New invasions of these species will be eliminated where possible and existing populations will be managed to avoid spread. Other species such as yellow star thistle are widespread across the state but are just beginning to spread to the Sequoia National Forest and the Monument where more aggressive action is warranted.

The Sequoia National Forest is actively mapping invasive non-native species locations in and adjacent to the forest to monitor spread and detect new populations. On average 125 acres of invasive non-native species are being treated each year. The number of treated acres is expected to expand over the next five years.

Most ground-disturbing activity can promote invasive non-native species disturbance and should be carefully monitored. This includes fuel-break maintenance, firefighting, mechanical fuels reduction and restoration treatments, road maintenance, and grazing. Appropriate timing, intensity, and frequency of fire use can either suppress invasive non-native species or favor them.

Current Management Direction

Management direction related to the management and prevention of invasive non-native species includes:

FSM 2081.03: Requires that a weed risk assessment be conducted when any ground disturbing activity is proposed. Determine the risk of introducing or spreading noxious weeds associated with the proposed action. Projects having moderate to high risk of introducing or spreading noxious weeds must identify noxious weed control measures that must be undertaken during project implementation.

Executive Order 13112 of Feb. 3, 1999: Directs federal agencies to prevent the introduction of invasive species, detect and respond rapidly to and control such species, not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species unless the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with

the actions.

2001 Sierra Nevada Forest Plan Amendment (2001 SNFPA): The Record of Decision (ROD) for the 2001 Sierra Nevada Forest Plan identified standards and guidelines applicable to motorized travel management and noxious weeds, which will be considered during the analysis process.

Regional Native Plant Policies (USDA 2008 FSM Chapter 2070):

- Maintain, restore or rehabilitate native ecosystems so that they are self-sustaining, resistant to invasion by non-native invasive species and/or provide habitat for a broad range of species including, threatened, endangered, and rare species.

- Maintain adequate protection for soil and water resources, through timely and effective revegetation of disturbed sites that could not be restored naturally.

- Promote the use of native plant materials for the revegetation, rehabilitation and restoration of native ecosystems.

- Promote the appropriate use and availability of both native and non-native plant materials.

- Cooperate with other federal agencies, state agencies and local governments, tribes, academic institutions and the private sector to increase the knowledge and availability of native plant materials, including developing sources of genetically appropriate plant materials.

- Increase and disseminate information which will guide the selection, use, and availability of genetically appropriate plant materials.

- Promote the study, planning, and implementation of actions which will maintain, restore and rehabilitate native ecosystems on NFS lands and other lands administered by the Forest Service and in the United States.

Description of Proposal

Below is a description of elements of the six alternatives in the Monument draft EIS considered important to management of invasive non-native species (noxious weeds). A complete description of the alternatives can be found in Chapter 2 of the Monument draft EIS.

No Action Alternative

All alternatives (except Alternative E) contain 15 standards and guidelines for management of invasive non-native species taken from the 2001 Framework:

- Follow Forest Service Manual (FSM 2080) direction pertaining to integrated weed management when planning weed control projects.

- Inform forest users, local agencies, special use permittees, groups, and organizations in

communities near national forests about noxious weed prevention and management.

- Work cooperatively with California and Nevada State agencies and individual counties (for example, Cooperative Weed Management Areas) to: (1) prevent the introduction and establishment of noxious weed infestations and (2) control existing infestations.

- As part of project planning, conduct a noxious weed risk assessment to determine risks for weed spread (high, moderate, or low) associated with different types of proposed management activities. Refer to weed prevention practices in the Regional Noxious Weed Management Strategy to develop mitigation measures for high and moderate risk activities.

- When prescribed in project-level noxious weed risk assessments, require off-road equipment and vehicles (both Forest Service and contracted) used for project implementation to be weed free. Refer to weed prevention practices in the Regional Noxious Weed Management Strategy.

- Minimize weed spread by incorporating weed prevention and control measures into ongoing management or maintenance activities that involve ground disturbance or the possibility of spreading weeds. Refer to weed prevention practices in the Regional Noxious Weed Management Strategy.

- Conduct follow-up inspections of ground disturbing activities to ensure adherence to the Regional Noxious Weed Management Strategy.

- Encourage use of certified weed free hay and straw. Cooperate with other agencies and the public in developing a certification program for weed free hay and straw. Phase in the program as certified weed free hay and straw becomes available. This standard and guideline applies to pack and saddle stock used by the public, livestock permittees, outfitter guide permittees, and local, State, and Federal agencies.

- Include weed prevention measures, as necessary, when amending or re-issuing permits (including, but not limited to, livestock grazing and special uses, such as pack stock operator permits).

- Include weed prevention measures and weed control treatments in mining plans of operation and reclamation plans. Refer to weed prevention practices in the Regional Noxious Weed Management

- Strategy. Monitor for weeds, as appropriate, for 2 years after project implementation (assuming no weed introductions have occurred).

- Conduct a risk analysis for weed spread associated with burned area emergency rehabilitation (BAER) treatments. The BAER team is responsible for conducting this analysis. Monitor and treat weed infestations for 3 years after the fire.

- During landscape analysis or project-level planning, consider restoring or revegetating degraded ecosystems to minimize the potential for noxious weed reinfestations. Adhere to regional native plant policies for revegetation.

- Consult with Native Americans to determine priority areas for weed prevention and control where traditional gathering areas are threatened by weed infestations.

- Complete noxious weed inventories, based on a regional protocol, within 3 years of the signing of the record of decision for the 2001 Sierra Nevada Forest Plan Amendment Project. Review and update these inventories on an annual basis.

Common to All Alternatives (except Alternative E)

In the DEIS, All Action Alternatives (except E) included the same 15 Standards and Guidelines for Forest Service management of invasive non-native species found in the No Action Alternative above. One of these Standards and Guidelines is now considered to be duplicative of law, regulation, or policy. This item is not included in the FEIS as a standard and guideline, but is now included in the Legal and Regulatory Compliance section. Therefore in the FEIS, all action alternatives (except Alternative E) will only contain 14 Standards and Guidelines for Forest Service management of invasive non-native species:

- Inform forest users, local agencies, special use permittees, groups, and organizations in communities near national forests about noxious weed prevention and management.

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Alternative E

Alternative E contains no standards and guidelines for management of invasive non-native species.

Affected Environment

The Monument within the western portion of the Sequoia National Forest encompasses a broad range of habitats and elevations, ranging from blue oak woodland at 1,000 feet to Upper Montane Red Fir Forest at over 8,400 feet. Four major biotic provinces converge on the Sequoia National Forest. The southern Sierra Nevada is a floristic melting pot between the Central Valley and the Mojave Desert and also between the High Sierra and the southern California Mountains.

The Forest Service Manual (USDA Forest Service 2000) defines invasive non-native species (noxious weeds) as:

“Those plant species designated as noxious weeds by Federal or State law. Noxious weeds generally possess one or more of the following characteristics: aggressive and difficult to manage, poisonous, toxic, parasitic, a carrier or host of serious insects or disease, and generally nonnative.”

The Manual further defines undesirable plants as:

“Plant species that are classified as undesirable, noxious, harmful, exotic, injurious, or poisonous, pursuant to State or Federal laws, including those designated by the Secretaries of Agriculture or the Interior.”

For the purpose of the draft EIS invasive non-native species are those plants with an extraordinary capacity for multiplication and spread at the expense of native plants. They may or may not be officially designated as noxious weeds.

Invasive non-native species are a growing problem in the Monument, as well as on adjacent lands and statewide. Noxious weeds were one of five major issues for the Sierra Nevada identified in the 2001 Sierra Nevada Forest Plan Amendment (2001 SNFPA). The 2001 SNFPA and other sources provide more detail on the extent and process of invasive non-native species than the summarized version provided here.

Many people are unaware of the extent of noxious weed problems on the Monument and generally in the Sierra Nevada. In fact, the spread of the some of the most aggressive species of pest plants is still in its initial stages. However, several species of highly invasive non-native species are poised to spread extensively throughout the Sierra Nevada, to the detriment of nearly all values and products the public expects from national forests (CIPC 2011). Whether the concern is sustaining forage for livestock and wildlife, successful reforestation, aesthetic appreciation of natural scenery, recreation, habitat for common and rare wildlife and plant species, or native biodiversity in general, invasive non-native species sweep across landscapes and reduce the availability of all of these resources.

There are 31 invasive non-native species known to occur within or directly adjacent to the Sequoia National Forest. Of these, 17 species are currently known to occur within the Monument. The species are shown in the following table. Of these 17 species, 7 are ranked as high priority species. In addition, there are a total of 33 known invasive non-native species occurrences within the analysis area, of which 13 are occurrences of high priority species. The figures provided in the following table are based on currently mapped occurrences, and for the medium and low priority species in particular, the figures likely underestimate the abundance of these species, as there are certainly many unmapped occurrences at this time.

Table 1 - Noxious Weed Occurrence In or Proximal to the Giant Sequoia National Monument

Scientific Name	Common Name	Cal IPC Pest Rating	CDFA Pest Rating	Acres (estimated)	Monument Priority
Ailanthus altissima	Tree of Heaven	Moderate	-	100	High
Brassica nigra	Black mustard	Moderate	-	100	M
Bromus tectorum	Cheatgrass	High	-	1,000	L
Carduus pycnicephalus	Italian thistle	Moderate	C	100	M

Centaurea melitensis	Tocalote	Moderate	-	100	M
Centaurea solstitialis	Yellow star-thistle	High	C	30	High
Cirsium vulgare	Bull thistle	Moderate	-	100	High
Cytisus scoparius	Scotch broom	High	C	5	High
Foeniculum vulgare	Fennel	High	-	5	L
Hypericum perforatum	Klamath weed	Moderate	C	25	High
Robinia pseudoacacia	Black locust	Limited	-	5	M
Rubus armeniacus	Himalayan blackberry	High		5	L
Salsola tragus (S.iberica)	Russian thistle	Limited	C	100	L
Silybum marianum	Milk thistle	Limited	-	20	L
Taeniatherum caputmedusae	Medusahead	A-1	C	200	M
Tribulus terrestris	Puncture vine		C	40	L
Verbascum thapsus	Woolly mullein	B	-	200	M

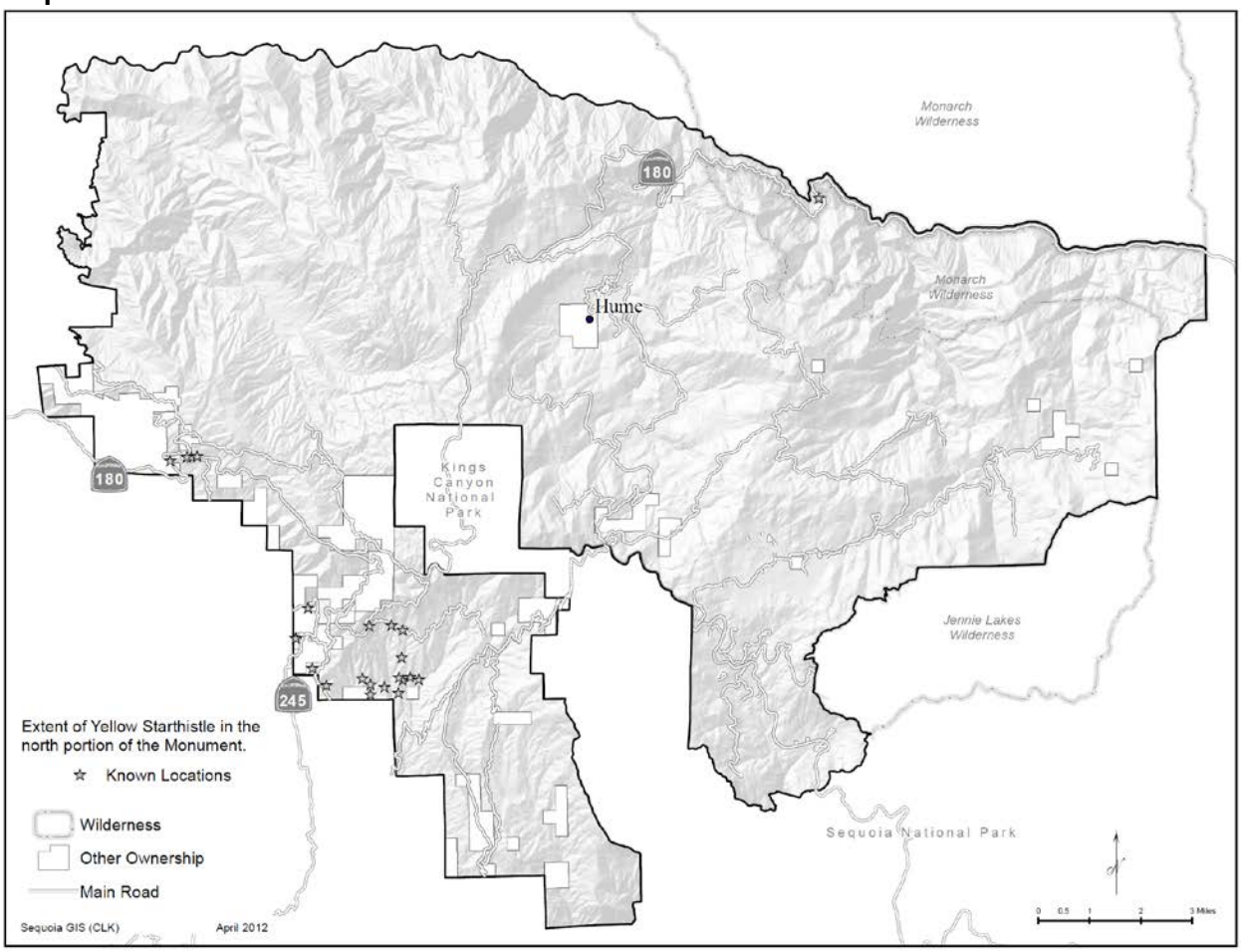
1. A pest of known economic or environmental detriment and, if present in California, it is usually widespread. C-rated organisms are eligible to enter the state as long as the commodities with which they are associated conform to pest cleanliness standards when found in nurserystock shipments. If found in the state, they are subject to regulations designed to retard spread or to suppress at the discretion of the individual county agricultural commissioner. There is no state enforced action other than providing for pest cleanliness.

The Sequoia National Forest is actively mapping invasive non-native species locations in and adjacent to the forest to monitor spread and detect new populations. On average, 125 acres of invasive non-native species are being treated each year. The number of treated acres is expected to remain at about this level over the next five years.

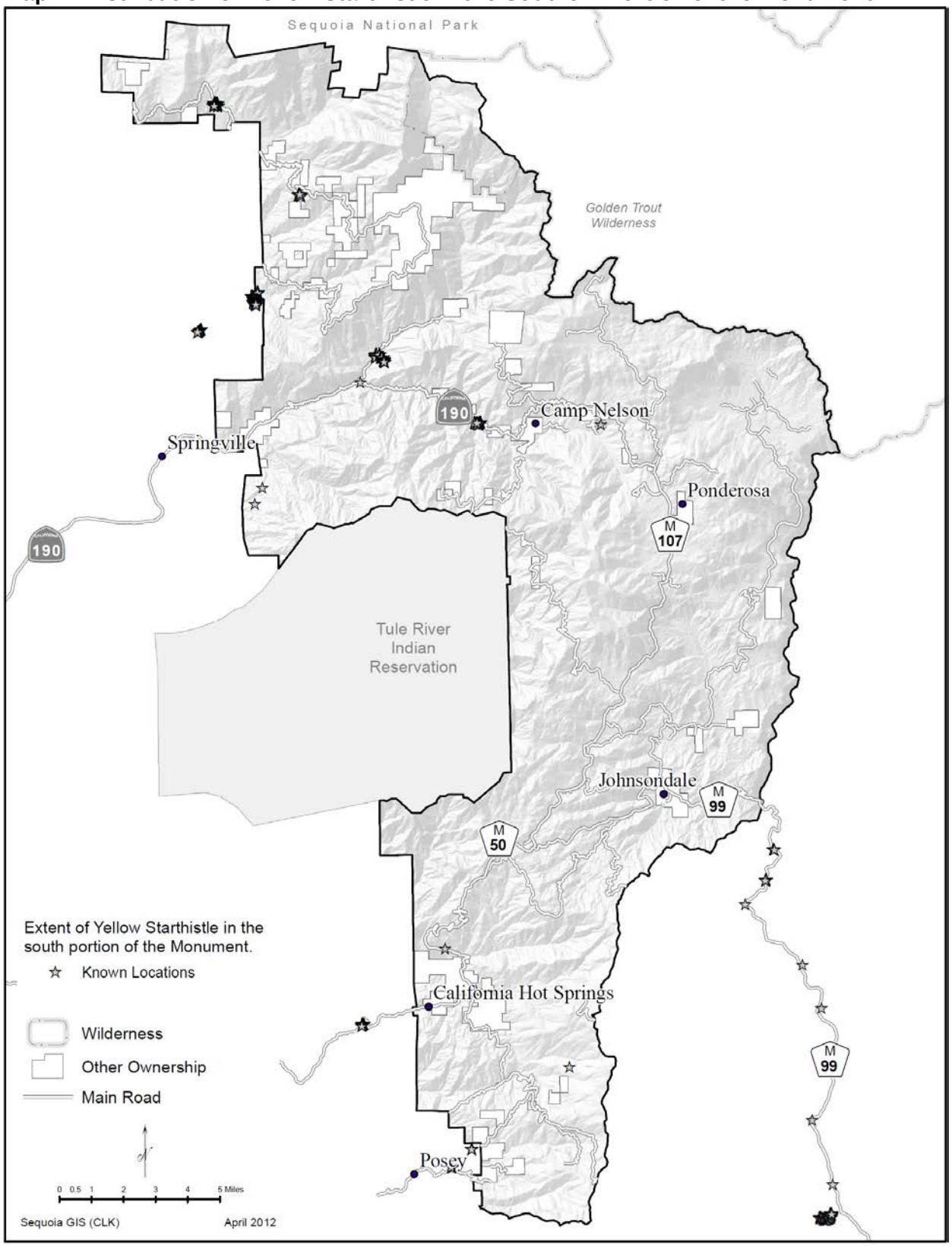
The known distributions, on and near the Monument, of four invasive non-native species (yellow star thistle, tree of heaven, scotch broom, and bull thistle) considered to be the most destructive

and invasive are shown in the following maps (there are no mapped populations of the tree of heaven, scotch broom, or bull thistle in the northern portion of the Monument).

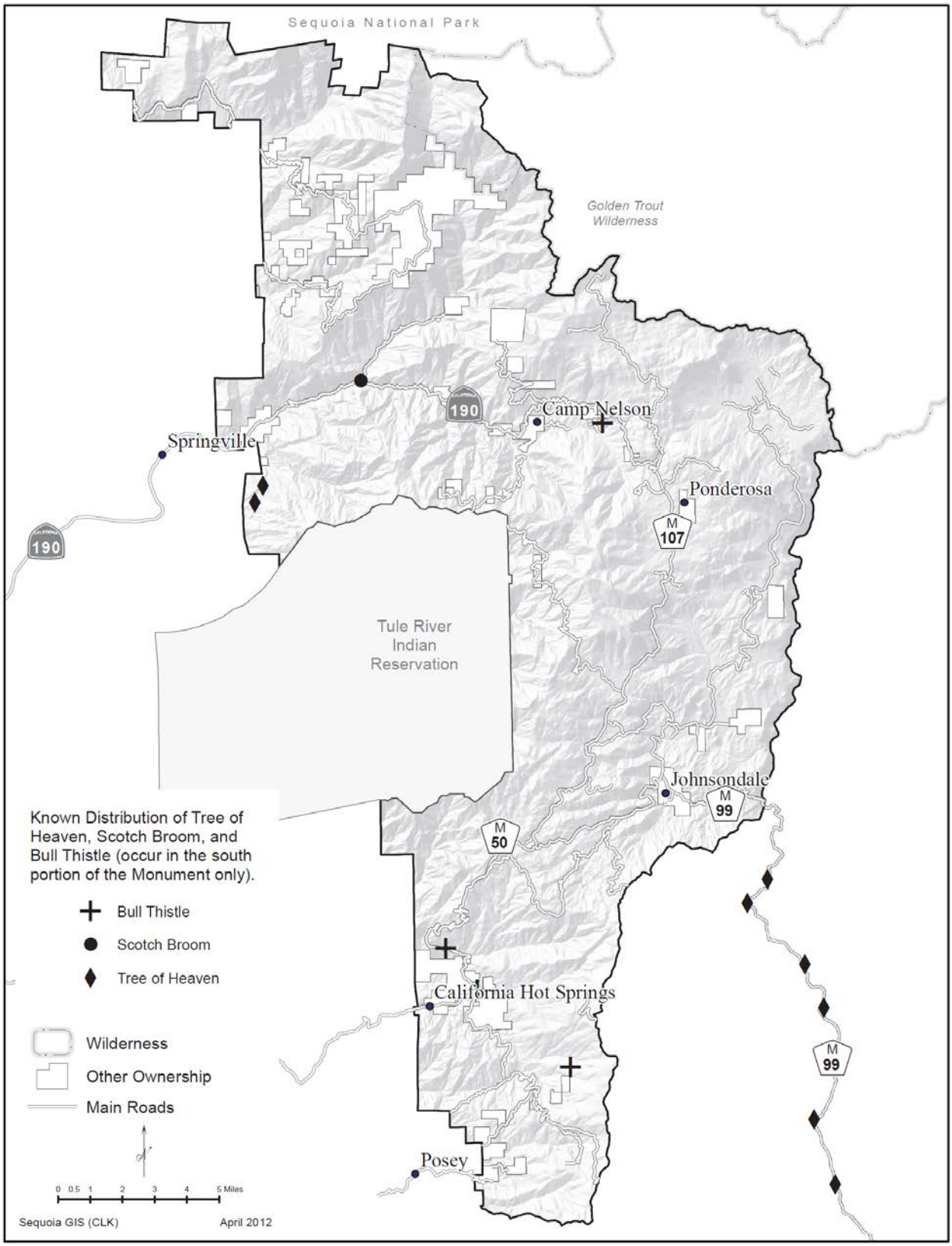
Map 1 - Distribution of Yellow Starthistle in the Northern Portion of the Monument



Map 2 - Distribution of Yellow Starthistle in the Southern Portion of the Monument



Map 3 - Distribution of Tree of Heaven, Scotch Broom, and Bull Thistle in the Southern Block of the Monument



Biology of Invasive Non-native Species

These 17 invasive non-native species in the Monument vary in their degree of invasiveness and competitiveness. As a result, each of these invasive non-native species warrant different levels of management concern. Although all of these species out-compete native plants, compromising biodiversity, some species (for example, black mustard, cheatgrass, mullein, and tocalote) are so widespread that extensive programs of eradication would not be practical. However, measures taken to prevent weed spread in general would help minimize further spread of these pests. Careful attention to the type and timing of Forest Service activities can help diminish the presence of some species, such as black mustard and cheatgrass.

On the other hand, every effort will be made to control and eradicate highly aggressive invasive non-native species like yellow star thistle, scotch thistle, and tree of heaven. Invasions of these species into the Sierra Nevada are generally in early stages; however, these species have caused tremendous ecological and economic damage in other parts of the United States (Olsen 1999).

One reason invasive non-native species are so destructive is that they arrive in this country without the co-evolved predators, pathogens, and competitors that keep their populations in balance in their native habitat (Westbrooks 1998). For example, yellow star thistle is not a pest in southern Eurasia, where its populations are controlled by at least 40 insect species (Thomsen et al. 1996). Certain biological characteristics can also make invasive non-native species exceptionally successful invaders (Rejmanek 1999, Westbrooks 1998). Biological traits of individual invasive non-native species vary, but most possess one or more of the following features that allow them to rapidly invade new areas and displace native vegetation:

Early maturation (they begin growth and reproduction earlier in the year than native plants) High reproductive rates (they produce exceptionally high numbers of seeds or vegetative propagules) Long-lived in soil seed bank

Adaptations for spread with crop seeds and by natural agents, such as wind or animals Production of biological toxins that suppress the growth of neighboring plants Spiny parts, such as thorns or prickles, that repel grazing animals (and humans) Roots with extra capacity for storing food reserves

Deep roots that extend below the rooting profile of native plants (they out-compete natives for water and nutrients)

Survival and seed production under harsh conditions High photosynthetic rates, which give weeds a competitive advantage

Environmental Effects

Legal and Regulatory Compliance

FSM 2081.03: Requires that a weed risk assessment be conducted when any ground disturbing activity is proposed. Determine the risk of introducing or spreading noxious weeds associated

with the proposed action. Projects having moderate to high risk of introducing or spreading noxious weeds must identify noxious weed control measures that must be undertaken during project implementation.

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- Maintain adequate protection for soil and water resources, through timely and effective revegetation of disturbed sites that could not be restored naturally.

- Promote the use of native plant materials for the revegetation, rehabilitation and restoration of native ecosystems.

- Promote the appropriate use and availability of both native and non-native plant materials.

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- Increase and disseminate information which will guide the selection, use, and availability of genetically appropriate plant materials.

- Promote the study, planning, and implementation of actions which will maintain, restore and rehabilitate native ecosystems on NFS lands and other lands administered by the Forest Service and in the United States.

Standards and Guidelines

Description of Proposal

Below is a description of elements of the six alternatives in the Monument draft EIS considered

important to management of invasive non-native species (noxious weeds). A complete description of the alternatives can be found in Chapter 2 of the Monument draft EIS.

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- Inform forest users, local agencies, special use permittees, groups, and organizations in communities near national forests about noxious weed prevention and management.

- Work cooperatively with California and Nevada State agencies and individual counties (for example, Cooperative Weed Management Areas) to: (1) prevent the introduction and establishment of noxious weed infestations and (2) control existing infestations.

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- Include weed prevention measures, as necessary, when amending or re-issuing permits (including, but not limited to, livestock grazing and special uses, such as pack stock operator permits).

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- During landscape analysis or project-level planning, consider restoring or revegetating degraded ecosystems to minimize the potential for noxious weed reinfestations. Adhere to regional native plant policies for revegetation.

- Consult with Native Americans to determine priority areas for weed prevention and control where traditional gathering areas are threatened by weed infestations.

- Complete noxious weed inventories, based on a regional protocol, within 3 years of the signing of the record of decision for the 2001 Sierra Nevada Forest Plan Amendment Project. Review and update these inventories on an annual basis.

Common to All Alternatives (except Alternative E)

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Alternative E

Alternative E contains no standards and guidelines for management of invasive non-native species.

Assumptions and Methodology

Measures and Factors Used to Evaluate Alternatives

The invasive non-native species management strategy standards and guidelines are nearly identical for all of the action alternatives. The standards and guidelines provide a prevention-based approach to integrated invasive non-native species management. Effective

implementation of these standards and guidelines would reduce the number of acres infested by noxious invasive non-native species and establish a highly effective system of preventing invasive non-native species spread into new areas. However, no prevention method is 100 percent effective; invasive non-native species seeds will always be distributed into new areas, either inadvertently by humans or by vectors beyond human control, such as wind, water, and wildlife.

The alternatives are evaluated based on the potential for Forest Service management activities to change or successfully contain and reverse invasive non-native species infestations. The following factors were used to compare the effects of the alternatives on noxious weed spread and control:

Relative risk of wildfire (wildfire acres projected to burn annually)

Wildfire areas are especially vulnerable to invasive non-native species infestation because: (1) equipment used in wildfire suppression and burned area emergency rehabilitation can readily bring weed seeds into an area; and (2) burned areas provide ideal conditions for invasive non-native species germination. Invasive non-native species populations can easily gain a foothold before the native vegetation has a chance to recover from the fire. Invasive non-native species then become permanently established in the area unless they are promptly eradicated.

Acres of annual mechanical fuels treatments and placement or pattern of treatments on the landscape

Treatments that create continuous openings and disturb soil increase opportunities for the spread of invasive non-native species to new areas and for existing populations to expand. Fuel treatments create optimal conditions for the spread of invasive non-native species, especially when placed along roads or ridgetops. Along roads, vehicle traffic aids seed dispersal, and from ridgetops, wind-borne seeds are easily transported to new sites.

Acres of annual prescribed fire

Equipment and vehicles used to prepare burn sites and carry out prescribed burning can spread invasive non-native species; thus, alternatives with high acreages of prescribed burning have a higher risk of spreading invasive non-native species. Burned areas are susceptible to rapid invasive non-native species infestation: (1) invasive non-native species inadvertently brought into the burned area by equipment can readily become established; and (2) burned areas provide conditions that favor expansions of existing invasive non-native species populations. Restoring more natural fire regimes and enhancing or maintaining native biodiversity would offset this risk to an unknown degree by creating healthier, more resilient native plant communities.

Assumptions about Cooperation

The analysis of the alternatives assumes that cooperation and coordination among the Forest Service, other agencies, private landowners, and the general public will continue. The Forest Service will continue to participate in, and work toward, the goals of the California Interagency Coordinating Committee Memorandum of Understanding signed in 1995. Coordinated invasive

non-native species management will take place in the context of regional and local cooperative weed management areas, which allow effective strategy development and cost-sharing in specific areas to solve common invasive non-native species problems. Federal and other types of funding will continue to increase for cooperative invasive non-native species management work.

Assumptions about the Effectiveness of Public Education

The analysis of the alternatives assumes that education efforts will result in changes in people's behavior such that the spread of invasive non-native species is significantly slowed, and the public will support legislation funding weed management in California.

Dynamics of Invasive Non-native Species Spread

As of 1996, invasive non-native species had invaded at least 17 million acres of Federal lands in the West (USDA Forest Service 1998d), more than quadrupling their range between 1985 and 1995 (Westbrooks 1998). The current average rate of spread is estimated at 14 percent annually (Asher 1995). At this rate of increase, approximately 4,600 acres per day of western public lands are lost to invasive pest plants, such as leafy spurge, yellow star thistle, and spotted knapweed (Westbrooks 1998). This translates to approximately 1.5 million acres of public lands overtaken by new populations of weeds each year across the West. Despite these disturbing figures, over 90 percent of public lands in the west are still largely uninfested (Westbrooks 1998). This is especially true at middle to high elevations of the Sierra Nevada, where non-native plants are still sparsely distributed or entirely absent from vast areas (Schwartz et al. 1996).

One specific example of the rapidity of the spread of invasive non-native species in the Sierra Nevada in yellow star thistle. Yellow star thistle was once considered a minor annoyance, but it is now the most common invasive non-native species in California (DiTomaso et al. 1999, 2006), occurring in 56 of 58 counties (Pitcairn et al. 1999). Yellow star thistle was first introduced to California as a contaminant of alfalfa seed in the mid-1800s (Thomsen et al. 1996), and by 1958 had infested about 1.2 million acres (Maddox and Mayfield 1985). Since then, star thistle has expanded exponentially and now occupies at least 12 million acres, or about 12 percent of California.

The Process of Invasive Non-native Species Invasion

Any activity that moves soil or plant parts from one place to another has the potential to transport the seeds of invasive non-native species. In the Sierra Nevada, invasive non-native species infestations primarily occur where human activity or natural events have disturbed the soil. Soil disturbance allows new plants to become established, and invasive non-native species readily take advantage of reduced competition and increased sunlight, often at the expense of native vegetation.

The following sections describe specific types of areas in national forests where the majority of invasive non-native species are known to occur or have the greatest potential to become established in the future.

Roads

Vehicles can carry invasive non-native species when they pass through infestations or along the periphery of invasions, where seeds have been deposited (Sheley et al. 1999). Roadsides along major highways, general forest roads, and two-tracked non-maintained roads are primary routes for invasive non-native species establishment. Yellow star thistle expansion into the higher elevations of the Sierra Nevada appears to be related to movement up the roadsides (Schoenig 1999). Studies in Montana demonstrated that roads were primary arteries of spread for spotted knapweed (Mullin 1999).

Utility Corridors

High amounts of soil disturbance are associated with utility corridor construction and maintenance. The extensive network of hydroelectric development in the Sierra Nevada has created many miles of linear openings and access roads that invite the infestation of invasive non-native species when seeds are carried in by maintenance equipment or vehicles.

Livestock Concentration Points

In areas where livestock congregate, such as around watering sites, corrals, trails, and along fence lines, the constant soil disturbance creates openings for noxious weed establishment. Livestock can also transport the seeds in their fur, wool, or manure (Sheley et al. 1999). Invasive non-native species can become established in other rangeland areas, for example on range sites with naturally high amounts of bare ground.

Vegetation Management Projects

Activities associated with timber harvest and mechanical fuels treatments, such as construction and use of roads, landings, and skid trails, disturb the soil. Invasive non-native species can also be introduced into an area by logging equipment. Logging equipment is moved from one site to another throughout the state, often without being washed. This practice offers abundant opportunity for invasive non-native species to be transported into new areas. Projects that create continuous openings, such as treatment in wildland urban intermix (WUI) zones, are especially conducive to the rapid spread of invasive non-native species.

Recreation Sites

Recreation areas and facilities, such as trails, trailheads, campgrounds, and dispersed camping areas, tend to harbor invasive non-native species infestations. These areas have high public use and constant soil disturbance, a combination that facilitates invasive non-native species introduction and infestation. Recreation and commercial horse and pack stock users may transport invasive non-native species seeds in the supplemental feed they use to feed their stock. Recreationists can disperse seeds on their clothing, footwear, camping equipment, and vehicles (Sheley et al. 1999).

Riparian Areas

Infestations of invasive non-native species are commonly found in riparian areas due to high levels of public activity in these areas, availability of moisture, and high potential for seed transportation through stream systems. Many invasive non-native species are adapted to riparian areas and rapidly become established on sites where soils have been disturbed, such as eroding stream banks, road and trail crossings, and undeveloped trails.

Burned Areas

Wildfire suppression requires control line construction, staging areas for fire equipment, and fire camps. For large fires, control lines, which are dug to bare mineral soil, can be many miles long and up to 100 to 300 feet wide in places, inadvertently providing optimal circumstances for the spread and establishment of invasive non-native species. Heavy equipment used on large fires can be imported from all over the state and from other states where invasive non-native species infestations are so heavy that equipment is highly likely to be contaminated unless it has been washed. Currently, most fire equipment is moved directly from fire to fire without being washed. Fire suppression activities cause soil disturbance and create opportunities for invasive non-native species to move into vulnerable burned areas in the first few years after the fire.

Wildland Urban Intermix (WUI)

Some invasive non-native species, such as scotch broom and gorse, are still sold in nurseries. In WUI areas, landowners often unwittingly plant these species adjacent to national forests. Efforts are being made to educate the nursery industry and the general public so that people are less likely to plant invasive non-native species, such as scotch broom, in areas where they can escape and cause problems.

Impacts of Invasive Non-native Species

When populations of invasive non-native plants dominate wildland sites, our ability to manage for healthy ecosystems is compromised or eliminated. The damage is essentially permanent when the cost of restoring the ecosystem to a healthy state is beyond our funding capacity as an agency and a society. Infestations of invasive non-native species have already caused permanent damage to public and private wildlands on millions of acres across the western United States. (Asher 1995, Forcella 1992, Thornberry 1995, USDA Forest Service 1998d).

Impacts on Vegetation

One of the most immediate effects of an invasive non-native species is the displacement of native plants. When the complex mix of native plants in an ecosystem is replaced by one or a few non-native aggressive invasive non-native species, the impacts reverberate throughout that ecosystem, including unseen microbial flora and fauna and major predators and insect pollinators, all of which contribute to normal ecosystem function.

Impacts on Soils

Infestations of invasive non-native species are frequently accompanied by increases in erosion and runoff (Lacey et al. 1989). This is especially true when weeds with deep taproots, like

yellow star thistle or knapweed, replace native grass species with fibrous root systems. Soil organic matter and available nitrogen decrease when topsoil is lost to erosion. In addition, soil nutrient and moisture reserves can be dramatically lowered in areas infested by invasive non-native species. Many invasive non-native species have secondary chemical compounds that inhibit native plant germination and growth. These compounds also affect nutrient cycling rates by inhibiting soil microbial fauna activity. Invasive non-native species can negatively affect soil quality by reducing water infiltration, causing soil temperatures to rise, and altering nutrient cycling (Olsen 1999).

Impacts on Wildlife

A rapid shift from a native plant community to a monoculture of invasive non-native species can remove forage, cover, and shelter for native animal species. Animals may either suffer reduced population growth or simply avoid the infested area. In Montana, elk winter range was badly infested with spotted knapweed. Elk use of this area significantly increased after the knapweed was treated with herbicides (Thompson 1996).

Impacts on Domestic Livestock

Invasive non-native species, such as leafy spurge, knapweed, and yellow star thistle, can significantly reduce the carrying capacity of grazing lands. Forage can be reduced between 35 and 90 percent on rangelands infested with invasive non-native species (USDI 1985). Many invasive non-native species are toxic to livestock. Yellow star thistle, for example, causes a nervous disorder that can kill horses.

Impacts on Riparian Areas

Certain species of invasive non-native species are adapted to moist or wet areas, and once they have taken over, riparian values are lost or diminished (Dudley 1998). In addition, stream systems can carry the seeds of invasive non-native species and propagules great distances, hastening their spread. Noxious aquatic plant species, such as purple loosestrife, may spread and dominate meadow and wetland ecosystems, impeding water flow and reducing crucial wetland habitats for wildlife.

Impacts on Recreation Opportunities

Recreation can be limited or curtailed altogether in areas infested by certain invasive non-native species. Recreation activities such as hiking and camping are no longer pleasant or feasible in areas overtaken by spiny invasive non-native species like musk thistle, Italian thistle, or yellow star thistle. Hunters and bird dogs are reluctant to use land infested with spiny noxious thistles. Whitewater rafters are affected when spiny or prickly invasive non-native species reduce access to hiking areas and campsites along rivers. Invasive non-native species in waterways and riparian areas may diminish fishing opportunities.

Economic Impacts

Invasive non-native species can affect economies by reducing production of valuable resources, such as livestock forage, timber, or recreation opportunities. In addition, controlling invasive

non-native species can be costly. Nationally, the economic impact of invasive non-native species is estimated to be $13 billion annually (Westbrooks 1998). Many invasive non-native species drastically reduce forage availability, reducing the value of land for livestock production. For example, in 1988 the value of a 1,360-acre ranch in Klamath County, Oregon was reduced from approximately $170,000 to $27,500 because of a severe leafy spurge infestation. Subsequently, the new owner spent $60,000 over 6 years on leafy spurge control with little success, indicating that for all practical purposes, this land has been permanently devalued for livestock grazing.

Trends in Noxious Weed Infestation Levels in the Sierra Nevada

Reviewing historical patterns of the spread of invasive non-native species in California helps us understand patterns observed in the Sierra Nevada. In California, the distribution of invasive non-native species is positively correlated with proximity to the coast and negatively correlated with elevation (Randall et al. 1998, CIPC 2011). The explanation for this is that many invasive non-native species were initially introduced along the coast where growing conditions are exceptionally mild, favoring the rapid expansion of newly introduced plants. Low elevation areas generally have more settled areas and agricultural lands, where large areas of disturbed vegetation and soils favor the spread of invasive non-native species (Randall et al. 1998, CIPC 2011). Although fewer invasive non-native species have become established in the higher elevations of the Sierra Nevada to date, it cannot be safely assumed that ecological barriers will prevent eventual invasive non-native species spread. Shorter growing seasons and harsher climatic conditions may slow the spread of invasive non-native species above 5,000 feet. However, invasive non-native species, such as yellow star thistle will continue to spread upslope, given time.

Fire and Fuels

Invasive non-native species tend to proliferate rapidly after wildfires and can be controlled or exacerbated by prescribed burning practices, depending on the timing and intensity of fire. Examples of invasions of invasive non-native species after wildfire in the Sierra Nevada abound. Musk thistle has become a serious problem in the Tahoe National Forest, probably brought in during a wildfire. Spanish broom populations exploded after the 1994 Big Creek Fire on the Sierra National Forest, yellow star thistle spread extensively in the Ishi Wilderness of the Lassen National Forest after wildfires. Prescribed fire has shown great promise in controlling yellow star thistle in the coast range and on the Stanislaus National Forest, but when this species is burned too early in its life cycle, populations are stimulated rather than reduced.

Lower Westside Hardwood Forest

The lower westside hardwood forest currently contains the worst invasive non-native species infestations in the Sierra Nevada. This zone is currently the entry point for many invasive non-native species into national forests in the Sierra. It is a major "source" for invasive non-native species that are moving upslope into coniferous forests. Most infestations are still primarily found at the western edge of the national forests in the foothill zone.

Increased residential development adjacent to national forests portends an increase in the invasion of invasive non-native species due to increases in: (1) soil disturbance; (2) the amount of plant material obtained through horticulturalists; (3) the quantity of non-natural habitats, such

as yards and pastures, that support populations of invasive non-native species; (4) the movement of landfill that may carry seeds of invasive non-native species; and (5) the movement of humans and their animals inadvertently carrying seeds of invasive non-native species (Schwartz et al. 1996).

Aquatic and Riparian Ecosystems

Some invasive non-native species are uniquely adapted to riparian habitat, and once established, may quickly dominate the vegetation. Riparian corridors provide travelways for animals and humans, which may carry invasive non-native species upstream into higher elevations. Stream currents also move invasive non-native species seeds downstream. Examples in the foothill zone are Russian olive and salt cedar, which are primarily increasing in the southern and eastern portions of the Sierra Nevada. These woody species can transform arid riparian areas into impenetrable thickets within 10 years or less (Schwartz et al. 1996). These species eliminate wildlife habitat and watering areas and may change stream hydrologic conditions resulting in increased sedimentation. Purple loosestrife can grow at high elevations; it is now near six national forests and occurs on the Eldorado National Forest. This tall, deep-rooted perennial forms solid stands, crowding out all other vegetation and impeding water flow.

Other species of special concern in aquatic or riparian habitats are bull thistle, perennial pepperweed, Spanish broom, and scotch broom. Restrictions on herbicide use near waterways can cause problems for managers when riparian values are being lost to invasive non-native species.

The Sequoia National Forest is actively mapping the location of invasive non-native species in and adjacent to the forest to monitor spread and detect new populations. On average, 125 acres of invasive non-native species are being treated each year. The number of treated acres is expected to expand over the next five years.

Determining Cumulative Effects

The cumulative effects analysis evaluates the six alternatives in context with past, present, and reasonably foreseeable actions that when taken collectively might negatively influence invasive non-native species. The cumulative effects of past management activities are incorporated within the existing condition in the Monument.

Climate change will certainly cause changes in the distribution and invasiveness of invasive non-native species. The precise effects of climate change on individual species are difficult to predict and will not be addressed in the effects analysis. For a more detailed description of how climate change may impact the Monument, see the effects on air resources section in chapter 4 of the Monument draft EIS.

Indirect Effects

Effects of the Alternatives on Invasive Non-native Species

Relative risk of wildfire (Wildfire Acres Projected to Burn Annually)

Standards and guidelines for addressing the spread of invasive non-native species during burned area emergency rehabilitation (BAER) efforts will help to reduce the chance of invasive non-native species spread after wildfires. That said, alternatives C, and D have the greatest risk for large, severe wildfires that could worsen existing invasive non-native species problems or create new ones. Alternatives B, E, and F reduce the projected number of acres burned by wildfire relative to what would occur under current management (Alternative A).

Annual Mechanical Treatment Acres and Placement of Treatments on the Landscape

Acres of mechanical treatments each year would be highest under Alternatives E and F. Alternatives A and B have an intermediate number of acres of mechanical treatments, and thus an intermediate level of risk. Alternatives C and D treat fewer acres annually; hence, these alternatives would have less risk from mechanical treatments. Thus, the spread of invasive non-native species spread directly attributable to mechanical treatments in Alternatives C and D would be lowest. However, even Alternative E treats less than one percent of the Monument each year. With implementation of standards and guidelines and with increased effectiveness of Cooperative Weed Management Areas, the overall risk from all action alternatives is low.

Alternatives A, B, E, and F have the greatest number of acres in the wildland urban intermix (WUI) zones where mechanical fuels treatments would be concentrated. The proximity of mechanical treatments to concentrations of people, vehicles, animals, and constant ground disturbance would make them highly likely to receive inoculations of invasive non-native species seeds. Alternatives C and D have much less less acreage designated as WUI.

Annual Prescribed Fire Acres

According to the SPECTRUM Model, Alternative B treats the greatest number of acres using prescribed fire, followed by Alternatives E and F. Alternatives A and C have intermediate levels of prescribed burning treatments. Alternative D has the lowest number of acres treated with prescribed fire. The risk of invasive non-native species spread and population growth from prescribed fire and associated activities is highest under Alternative B and lowest under Alternative D. As a result, Alternative B has the greatest risk of introducing invasive non-native species into new areas and spreading existing invasive non-native species populations. However, even Alternative B treats less than one percent of the Monument each year. With implementation of standards and guidelines and with increased effectiveness of Cooperative Weed Management Areas, the overall risk from all action alternatives is low.

Overall Treatment Acres for Fuels Reduction

The threat of increased invasive non-native species spread in the Sierra Nevada can be analyzed using the total number of acres treated by each alternative for fuel hazard reduction. The following ranking includes prescribed burning and mechanical treatments only; it does not include wildfire. Alternative B has the highest overall treatment acreage, followed by Alternatives F and A. Alternatives E and C have intermediate treatment acreages. Alternative D has the lowest number of acres treated. These treatments are targeted to a very specific portion of the Monument, primarily the WUI zone. The primary mechanism for addressing current risk and

future threat of invasive non-native species spread in treatment areas would be accomplished during site-specific environmental analysis.

Under all the action alternatives, the risk of invasive non-native species spread will be reduced by following the standards and guidelines for invasive non-native species management, and by the ongoing participation of the national forests in Cooperative Weed Management Areas. Even though alternatives with higher levels of activity bring about increased risk, they also bring increased opportunity for survey of site-specific project areas, which results in improved inventory of National Forest System lands.

Livestock Grazing

All alternatives are identical in continuing the current configuration and levels of livestock (cattle) grazing on existing allotments. Consequently, there are no differences in effects in relation to invasive non-native species. Livestock grazing will continued to be to be governed by existing standards and guidelines for invasive non-native species.

Conclusion

Although invasive non-native species spread standards and guidelines would be implemented under all alternatives to minimize, prevent, and detect new infestations, it is assumed that there would be greater risk of infestation with increased mechanical treatment. All other factors being equal, Alternatives A, B, E, and F may have a higher potential for introduction and spread of invasive non-native species because of their greater reliance on mechanical treatments. Alternatives C and D appear to have lower potential for introduction and spread of invasive non-native species populations because of a greater reliance on prescribed fire. With appropriate control measures, all alternatives would be within acceptable levels of risk.

Cumulative Effects

The present distribution and abundance of invasive non-native species are directly related to historical land uses, the presence of new invasive non-native species vectors, and increased habitat vulnerability resulting from changed disturbance regimes. The Sequoia National Forest and the Monument are surrounded by developed rural and urban areas. These developed areas with their agricultural development and recreation activities will continue to be a source of disturbance and the introduction of invasive non-native species in the Monument. Urban infrastructure, including state and county roads and highways that pass through National Forest System lands, will also continue to carry invasive non-native species into the Monument.

The presence of a human population around the Monument also serves to stress habitats found on National Forest System lands. These stresses come from air pollution, altered fire regimes, and altered stream flows. Stressed habitats are more vulnerable to invasion by invasive non-native species. These past, current, and future impacts on the both private and public lands in the Monument combine to produce a high risk of introducing and spreading invasive non-native species. Current and reasonably foreseeable actions to control invasive non-native species are not sufficient to stem the continued introduction of invasive non-native species.

The cumulative effect of ground-disturbing activities linked by roads has created a system highly conducive to the establishment of invasive non-native species. As these populations become

established both on the Monument and adjacent private and public lands, propagation can accelerate exponentially. Further establishment of invasive non-native species would jeopardize the health of ecosystems by altering ecosystem processes that affect soil chemistry, hydrology, nutrient cycling, intensity, and frequency of fire, sediment deposition and erosion.

invasive non-native species would affect recreation opportunities and natural scenic values, reduce biological diversity and degrade wildlife habitat. With the loss of plant diversity, wildlife habitat, and forage values comes a host of impacts on the uses of such resources, such as hunting, wildlife and wildflower viewing, wilderness values, and livestock grazing. With the loss of these uses come the potential for economic losses to the human communities surrounding the national forests.

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