3.06 INVASIVE SPECIES

Analysis Framework: Statute, Regulation, Forest Plan and Other Direction

The following direction guides management of invasive plants on NFS lands:

- Executive Order 13112 Invasive Species 64 FR 6183 (Clinton 1999)
- FSM 2900 (USDA 2011)
- Pacific Southwest Region Noxious Weed Management Strategy (USDA 2000)
- Noxious Weed Management Standards and Guidelines (USDA 2010a, p.52)

The Forest Plan Compliance (project record) document identifies the Forest Plan Standards and Guidelines that specifically apply to this project and related information about compliance with the Forest Plan.

Effects Analysis Methodology

Assumptions Specific to Invasive Species

- Existing plant survey data covers approximately 98% of the total project area.
- New and expanding infestations will result from habitat alterations caused by the fire (e.g. decreased canopy cover, increased nitrogen and water availability) and fire suppression activities.
- The risk of creating new or expanding invasive populations throughout the project area depends on a variety of factors (these factors are listed in the Summary of Effects Analysis across All Alternatives section).
- Without specific prevention and control measures, invasive non-native plants (noxious weeds) will continue to spread along and within project areas and into adjacent areas.
- Weeds are likely to persist long term once they are established in meadows.

Data Sources

- GIS layers of invasive plant infestations and units based on GIS shapefiles provided by the Mi-Wok and Groveland District botanists with data collected from 2006 to 2015.
- Information on species status, distribution, and ecology was derived from general literature reviews, Forest Service documents, the Forest Service Fire Effects Information System, California Department of Fish and Wildlife, various field books, floras, and personal communications. Site surveys, in conjunction with literature and input from the District botanists were used to determine the potential occurrence of each species, its habitat and its priority for eradication and control.

Invasive Species Indicators

- Acres within ground-disturbing project locations containing infestations of invasive plant species.
- Acres planned for eradication treatments or reforestation (site preparation and release) treatments.

Invasive Species Methodology by Action

This analysis evaluates the factors influencing invasive plant introduction and spread by considering the risks of, and vulnerability to, invasive plant establishment.

Affected Environment

Existing Conditions

Thirty species of non-native and invasive plants are present or adjacent to (within 5 miles) the project area (Table 3.06-1). Table 3.06-1 does not list Bachelor button, cheat grass, scotch broom, and Spanish broom which are known within the Rim Fire but not proposed for treatment. Table 3.06-1

also shows the non-native invasive species (NNIS) known treatment population acres for each alternative (this includes an additional 20% over the mapped acreage for medusahead grass and tocalote and an additional 10% for all other species to account for population spread prior to treatment).

Table 3.06-1 Invasive Species within Rim Fire and Known Populations Proposed for Treatment

Name	In Rim Fire (acres)[1]	Alternative 1	Alternative 3	Alternative 4	Alternative 5	Project Priority[2]
Barbed goatgrass	4.70	3.71	3.71	3.71	3.71	High
Blackberry, cut-leaf	0.11	0.07	0.07	0.07	0.07	Low
Blackberry, Himalayan	24.56	27.02	5.50	5.50	27.02	Low
Black mustard	1.33	1.44	1.44	1.44	1.44	Moderate
Bull thistle	327.73	360.50	56.99	56.99	360.50	High (DI); Low (SP)
Canada thistle	0.29	0.04	0.04	0.04	0.04	High
Dyers woad	0.74	0.81	0.81	0.81	0.81	High
Field bindweed	0.73	<0.01	<0.01	<0.01	<0.01	Moderate
French broom	0.40	0.44	0.44	0.44	0.44	Moderate
Italian thistle	30.41	28.16	15.65	15.65	28.16	High
Johnsongrass[3]	4,297.94	42.97	<0.01	<0.01	42.97	Moderate
Klamathweed	2.20	1.34	1.29	1.29	1.34	Low
Medusahead grass	3,486.23	3,767.20	2,967.26	2,967.26	3,767.20	High
Milk thistle	0.35	0.13	0.13	0.13	0.13	Moderate
Oxeye Daisy	0.04	0.04	0.04	0.04	0.04	High
Perennial sweetpea	2.40	2.64	2.64	2.64	2.64	Moderate
Puncturevine	0.10	<0.01	<0.01	<0.01	<0.01	High
Shortpod mustard	0.04	0.04	0.04	0.04	0.04	Moderate
Spotted knapweed	1.23	0.96	0.80	0.80	0.96	High
Sulphur cinquefoil	0.07	0.08	0.08	0.08	0.08	High
Tall Sock destroyer	0.02	0.02	0.02	0.02	0.02	Low
Tocalote	1,045.80	493.03	0.47	0.47	493.03	High
Tree of Heaven	<0.01	<0.01	<0.01	<0.01	<0.01	Moderate
Tumble mustard	107.08	112.90	112.70	112.70	112.90	Moderate
Woolly mullein	196.23	215.85	15.97	15.97	215.85	Moderate (DI); Low (SP)
Yellow star-thistle	2,461.57	776.74	196.97	196.97	776.74	High
Totals[4]	**11,992.39**	**5,836.15**	**3,383.07**	**3,383.07**	**5,836.15**	

DI=Dense Infestations; SP=Scattered Plants

[1] <0.01 indicates population size is less than one hundredth (0.01) of an acre.

[2] Project priority determined by invasive characteristics, habitat degradation potential, state rating, prevalence across the fire area, and control factors of the plant. In addition, the risk of potential seed and reproductive part spread from project activities was considered.

[3] Johnsongrass acres are mapped to heli-mulch units with actual treatment acres assumed to be one tenth of the acreage.

[4] Totals shown here are greater than the noxious weed treatment acres shown for each alternative in Chapter 2 due to overlapping populations of different species.

Ten species are considered a moderate risk, including: barbed goatgrass (*Aegilops triuncialis*), Italian thistle (*Carduus pycnocephalus*), tocalote (*Centaurea melitensis*), yellow star-thistle (*Centaurea solstitialis*), spotted knapweed (*Centaurea stoebe ssp. micranthos*), Canada thistle (*Cirsium arvense*), bull thistle (*Cirsium vulgare*), dyer's woad (*Isatis tinctoria*), medusahead grass (*Taeniatherum caput-medusae*) and puncturevine (*Tribulus terrestris*) are considered high risk species from project activities. Eleven other species, including, bachelor buttons (*Centaurea cyanus*), field bindweed (*Convolvulous arvensis*), Scotch broom (*Cytisus scoparius*), French broom (*Genista monspessulana*), shortpod mustard (*Hirschfeldia incana*), perennial sweetpea (*Lathyrus latifolius*), milkthistle (*Silybum marianum*), tumblemustard (*Sisymbrium altissimum*), johnsongrass (*Sorghum halepense*), Spanish broom (*Spartium junceum*) and woolly mullein (*Verbascum thapsus*). The remaining five species are considered low risk. The Noxious Weed Risk Assessment includes a complete discussion of characteristics specific to each species, habitat impacts and recommended management tools.

Past actions involving ground disturbing activities such as timber removal, fuel reduction, road and trail creation or maintenance, grazing, unauthorized motorized use and other dispersed recreation impacted invasive plant infestations across the project area. The invasive species known to occur within the project area before the Rim Fire were introduced and spread primarily through transport on vehicles, in straw and hay, on earthmoving, mowing or weed-eating equipment, and on animals and in their manure associated with these activities. Weed seeds also spread quickly down streams and upwind along lakes and reservoirs. Livestock grazing also contributed to weed spread, due to transportation on their fur, decreased native grass and forb cover from preferential grazing (avoiding the less palatable invasive species), trampling, and other soil disturbances (Olson 1999).

Given the current data (Table 3.06-1), Medusahead grass, tocalote, yellow star-thistle, bull thistle and johnsongrass are by far the most common species within the project area. Johnsongrass acreages are mapped to heli-mulch units, and actual treatment acres are assumed to be one tenth of the acreage shown in mapping. To a lesser extent, several other invasive weed species occur, primarily along roads. It should be noted however, that it is highly likely that many of the lower priority invasives (such as cheatgrass) are mapped at a fraction of their actual occurrence acreage given their commonality. All proposed treatment areas will be surveyed prior to implementation as per management requirements.

The risk of creating new or expanding populations depends on a variety of factors:

- **Species-specific dispersal traits of weeds**. Weed species with seeds dispersed by wind (Italian thistle), by tumbleweed (shortpod mustard), water (tamarisk), or animals (Medusahead grass) can potentially spread weed propagules miles from their original sources. Most seeds are not moved far from the parent plant, but a small proportion of seeds can be found large distances away. Even propagules with low innate dispersal abilities, such as stem fragments of giant reed or castor bean seeds which fall close to the plant, can be carried a great distance after initial dispersal by streams or surface runoff. However, species without wind, water, or animal-mediated dispersal are less likely to disperse propagules far from the original source.
- **Habitat disturbed**. While many weed species are generalists that can potentially colonize a fairly wide range of habitat types, those with ample nutrients and soil moisture or those that have been recently disturbed, are more susceptible to invasion. Additionally, the suite of weed species one would expect to colonize a site is dependent to some degree on the habitat where the disturbance occurred.
- **Regional patterns in weed occurrence and propagule pressure**. The project occurs across a transitional area with regards to microclimate, elevation, and vegetation communities. The most commonly observed weeds differed within these areas, possibly due to species-specific habitat preferences.
- **Type of ground disturbance**. The type of disturbance creates conditions favoring release and establishment of different weed species. For example, tree removal is expected to favor the establishment of weed species that do best in full sun, such as yellow star-thistle; burning is expected to favor the establishment of fire-adapted weed species such as French broom; and soil disturbance is expected to favor the establishment of early-colonizing weed species, such as mustards or tocalote, that respond favorably to disturbed, denuded soils.
- **Planned treatment of known infestations and use of standard management requirements**. Treatment of NNIS occurrences are planned in all of the action alternatives. Additional treatment of NNIS would occur through site preparation and release activities by herbicide in Alternatives 1, 4 and 5. All action alternatives propose treatment of NNIS, but prescribe different techniques and differing amounts of treatment. Standard management requirements would reduce the risk of spread within the project area and are prescribed for all action alternatives.

These factors were used to consider the risks associated with the establishment of new weed infestations due to project activities. In addition to these 5 factors, the results of the Noxious Weed Risk Assessment focused on risks associated with the 1) release of pre-existing but currently dormant weed seed banks at disturbed sites; 2) rapid build-up of transient weed seed banks at disturbed sites; and/or 3) creation of conditions favoring weed establishment at disturbed sites.

Environmental Consequences

Project-related activities under all action alternatives, could contribute to an increase in invasive plants in three major ways: 1) the creation of conditions that favor establishment of invasive plant (weed) species, such as soil disturbance, removal of native vegetation, or the breakup of cryptogamic crusts[1], 2) spread of new and pre-existing weed infestations into newly disturbed areas via project tools, equipment, and personnel; and 3) the subsequent release of pre-existing weed seedbanks from dormancy or the quick build-up of new weed seedbanks on disturbed soils.

Table 3.06-2 displays acreages for ground disturbing treatments in each alternative. The acreages listed are cumulative, and no attempt is made to remove overlapping areas of treatment. Treatments leading to soil disturbance and canopy reduction are likely to facilitate the spread of NNIS. Alternative 3 is the highest in cumulative acres of ground disturbing activities because of hand grubbing which would expose thousands of acres of bare soil (scattered in small patches across each unit) for up to five years. The other action alternatives have similar acres of disturbance, but the type of disturbance varies. Alternatives 1 and 4 would create more bare ground following prescribed burning activities as opposed to Alternative 5 which would hand thin young trees at age 7 and create small piles of slash for burning. These burned areas would create fertile habitat for invasive species, but be far more isolated and dispersed than the broadcast burns proposed in Alternatives 1 and 4.

Table 3.06-2 Ground Disturbing Activities by Alternative

Treatments	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Mechanized equipment	5,895	0	5,895	248	6,194
Deep till and forest cultivate	5,085	0	8,893	0	5,085
Release with grubbing[2]	0	0	14,415	0	0
Prescribed fire	21,300	0	21,300	32,112	0
Thin new plantations	0	0	0	0	25,331[1]
Totals[3] (acres)	**32,280**	**0**	**50,503**	**32,360**	**36,610**

[1] Treatment would only be done where needed to create desired ICO structure and to meet fire and fuels structure goals.
[2] Assumes 40% of the total acres will be disturbed through hand grubbing.
[3] Cumulative total acres of ground disturbing activities leading to soil disturbance and facilitating weed spread.

The results of the Noxious Weed Risk Assessment focused on risks associated with three avenues for weed proliferation: 1) the release of pre-existing, but currently dormant, weed seed banks at disturbed sites; 2) the rapid build-up of transient weed seed banks at disturbed sites; and 3) the creation of conditions favoring weed establishment at disturbed sites. The risks are labeled “high, moderate and low,” and are defined as follows:

- High: Chances of weed species infesting new areas range between 76 to 100%.
- Moderate: Chances of weed species infesting new areas range between 31 to 75%.
- Low: Chances of weed species infesting new areas range between 1 to 30%.

Each action alternative is expected in general to be high risk (a 76 to 100% chance) for the potential to establish new populations of invasive species, specifically those listed as high and moderate priority in Table 3.06-1. This high risk ranking was chosen after careful consideration of the first four factors listed in the Affected Environment section (e.g. weed species dispersal traits, habitat

[1] Cryptogamic crusts are biological soil crust composed of living cyanobacteria, green algae, brown algae, fungi, lichens, and/or mosses.

disturbed, regional patterns in weed occurrence and types of disturbance), and the three avenues for weed proliferation stated previously. For each of the action alternatives, the ranking was determined to be in the high category. Those areas that are outside of the historic fire burn return interval (i.e., burning more or less frequently) are expected to have an even higher risk (yet still within the high risk category) of experiencing vegetation type conversion in the project area.

Alternative 1 (Proposed Action)

DIRECT AND INDIRECT EFFECTS

Disturbance by heavy equipment can have long-term effects to soils and favor weed establishment if unmitigated. Heavy equipment can compact soils, reducing water infiltration and accelerating erosion. It can also displace soils and shear off vegetative roots. If these effects are severe, a loss of soil productivity may occur. Numerous passes by equipment over vegetation often causes plant mortality or severe injury, exposing the soil organic layer and making it more susceptible to erosion. Loss of vegetative cover and the soil organic layer reduces the ability of the soil to hold moisture. Many weed species are more capable of utilizing less productive soils with less soil moisture. In addition, some weeds produce secondary chemical compounds that inhibit native plant germination and growth. These compounds also affect nutrient cycling rates by inhibiting soil microbial fauna activity (Sheley et al. 1999).

Even those project sites in remote areas may be expected to contain an existing weed seedbank. Seedbanks are known to regularly contain a different suite of species than is represented by the standing vegetation due to succession, low reproduction rates of some perennials (by seed), and other factors (Thompson 2000). In most cases it is rare to find species in the seedbank that are not represented to any degree in the above-ground vegetation; the exception being seeds from invasive, aggressive, disturbance-adapted, and early colonizing weeds (Thompson 2000). For example, large cheatgrass seedbanks are commonly found throughout western North America, often regardless of such factors as remoteness of the site, grazing, or fire history. Within intact native communities these seeds are typically held in the above-ground vegetation or in crevices on cryptogamic crusts. Germination is therefore prevented until disturbance allows the cheatgrass seeds to come into contact with broken soil surfaces (Boudell et al. 2002).

Following establishment, new populations of weeds are often extremely difficult to eliminate, and even if controlled or eradicated, it may take several years or decades to re-establish native soil structure and biota. If allowed to expand, dense infestations can occur that not only displace native plants and animals, but also threaten natural ecosystems by fragmenting sensitive plant and animal habitat (Scott and Pratini 1995). For example, when equipment disturbance activities introduce or release weeds, the vegetative pattern is changed, often providing more flammable fuels into the system. As the weeds spread and increase in volume, an increase in ladder fuels occurs. Weeds such as Scotch broom, Medusahead, barbed goatgrass, yellow star-thistle and others, change the arrangement of vegetation, the amount of soil moisture at specific times of the year, the amount of fuel available to burn, and how fire behaves (Keeley et al. 2011). These changes in fire behavior often mean that areas that would not ordinarily burn frequently or at high intensity are now doing so (DiTomaso and Healy 2007). This is especially a concern in dry lava cap areas where weed species compete with sensitive plants.

Deep tilling under Alternative 1 would expose soil to colonization by weed species, but the associated planting could reduce this effect in the long term by establishing a canopy to discourage the continued occupation of the site by sun-loving weed species. Follow-up herbicide treatments would also greatly reduce the likelihood of weeds spreading in deep-tilling units. Prescribed burning would have mixed effects depending on the species response to fire, but in general clears the understory and provides areas for weeds to spread into.

Alternatives 1 and 5 have the highest number of weed treatment acres prescribed, 5,714 acres. Most of those acres (over 95%) would also be indirectly treated with herbicide during site preparation and release activities. These treatments and the implementation of standard management requirements reduce the risk of further weed spread from Alternative 1 from high to moderate.

CUMULATIVE EFFECTS

Factors which are not planned and are difficult to control (e.g., wildfire, dispersed recreation use, grazing, climate change) will likely have the greatest cumulative impact to native plant communities from the expansion of invasive plants for the action alternatives. Fully implementing any of these alternatives would add to this cumulative effect. For the purpose of this analysis, cumulative effects of past activities or natural events are represented within the existing conditions.

All of the activities listed in Appendix B, which spatially and temporally intersect with the project area, will contribute to effects on invasive plant proliferation. Within the project area, the Rim HT and the Rim Recovery projects are the two largest sources of ground disturbance for noxious weeds. These projects have the primary activities that will alter forest vegetation and impact invasive plants; most of the weed risk assessments for these projects show the risk to be moderate when management requirements are followed. Recreation management, road and trail work and decommissioning of unauthorized routes are additional ground disturbing activities anticipated to occur in the foreseeable future. Livestock grazing within the project area (13 allotments) may also proliferate weeds. All of these activities, in addition to other recreation activities such as dispersed camping, were ranked as low to moderate risk.

These present and future projects are cumulative in nature in that some of them overlap spatially with the project areas, but all of them impact the ability of the Forest Service to feasibly and adequately manage invasive plant proliferation. With all the different projects occurring across the forest (hazard tree removal, fuel treatments, etc.), several of which are thousands of acres in size in addition to the large size of the Rim Fire itself, it becomes very difficult to physically visit all the affected areas, let alone perform time consuming hand removal of invasives in an adequate manner. Because of overlapping implementation timeframes of this project and above mentioned projects, it is also difficult to acquire the trained personnel necessary for mitigating project impacts.

Alternative 2 (No Action)

DIRECT AND INDIRECT EFFECTS

Under Alternative 2, areas which currently have invasive plants would continue to support these species, providing seed sources for dispersal into adjacent areas. However, this alternative would eliminate the high risk of directly and indirectly spreading weeds from ground disturbing activities (all part of Alternatives 1, 3, 4 and 5). The reduction in invasive plant spread would equate to lower risk for vegetation type conversion to non-natives and better habitat and hydrologic function throughout the project area.

The risk of noxious weed spread is the highest under Alternative 2. Known noxious weeds would not be actively managed under this alternative. Additionally, much of the project would remain in a disturbed state and canopy levels would not be re-established. The majority of the known noxious weeds in the project area are sun loving and are prone to being shaded out under heavy canopies. The most important factors for reducing the risk of weed spread in the project area are reforestation treatments which re-establish resiliency to noxious weed invasion in conjunction with treatment of known noxious weeds.

CUMULATIVE EFFECTS

All of the activities listed in Appendix B, which spatially and temporally intersect with the project area, will contribute to effects on invasive plant proliferation. Since no weed eradication would occur

under Alternative 2, existing populations would also continue to spread throughout this area and adjacent activities would contribute to this spread. Factors that are not planned and difficult to control (e.g., wildfire, dispersed recreation use, grazing, and climate change) will likely pose the greatest risk of proliferating invasive plants.

Alternative 3

DIRECT AND INDIRECT EFFECTS

Alternative 3 has a higher risk to spread weeds in the project area compared to Alternative 1. This alternative proposes 21,300 acres of hand grubbing that would expose thousands of acres of bare mineral soil for 5 years. Additionally this would preclude the indirect treatment of weeds through herbicide release. Alternative 3 only allows for hand and non-herbicide treatments of known infestations within the project area on 3,131 acres of weeds (2,583 fewer acres than Alternative 1). Non-herbicide treatments would likely result in less effective control of some species and require more treatments to ensure full eradication of those populations that can be eliminated. In summary, because Alternative 3 has the highest amount of ground disturbance and less effective noxious weed treatments the risk of noxious weed spread is high.

CUMULATIVE EFFECTS

Same as Alternative 1.

Alternative 4

DIRECT AND INDIRECT EFFECTS

Alternative 4 has a larger footprint than Alternatives 1 and 5 and relies heavily on natural regeneration and prescribed fire to meet project objectives. Some acres of indirect herbicide control of noxious weeds would occur during chemical site preparation and release treatments that overlap weeds. All planned noxious weed treatment would be done without herbicides, and would have the same effects as Alternative 3. The risk of spreading weeds through Alternative 4 would be high due to the larger amount of ground disturbance, indirect treatment of weeds with herbicides during reforestation, and the planned treatment of 3,131 acres of known infestations.

CUMULATIVE EFFECTS

Similar to Alternative 1, but in a larger spatial area.

Alternative 5

DIRECT AND INDIRECT EFFECTS

Alternative 5 is similar to Alternative 1. Differences include; additional acres of reforestation versus natural regeneration and no post-planting broadcast burning, but instead pile burning within plantations thinned to achieve ICO structure and fuels objectives. This would leave far fewer acres of exposed soil resulting in lower potential weed spread. The acres of weeds planned for treatment with herbicide and those indirectly treated with herbicide are the same as Alternative 1. Alternative 5 would have a moderate risk of increasing the chance of weed spread for the same reasons as those presented in Alternative 1.

CUMULATIVE EFFECTS

Same as Alternative 1.

Summary of Effects Analysis across All Alternatives

Action alternatives 1 and 5 have roughly the same affected environment and acreage of invasive plant species across similar treatments (Table 3.06-2). The direct, indirect and cumulative effects are also expected to be very similar. These alternatives are expected to have a moderate risk of spreading

invasives. Alternative 4 has a high risk due to its increased amount of ground disturbing activities. Alternative 3 has a high risk of spreading weeds due to a high level of ground disturbance, no indirect benefit of treating weeds through reforestation activities and the use of non-herbicide tools for planned weed treatments. Alternative 2 has a high risk of spreading weeds since no treatments would occur and canopy levels would not be returned to pre-fire levels as quickly.