



INVASIVE PLANT MANAGEMENT PROGRAM 2018 WORK PLAN

Invasive plant management in Yosemite National Park is based upon Integrated Pest Management, practical experience and the best available science. This work plan summarizes 2017 invasive plant management efforts and describes control actions proposed for 2018.

Comments are welcome. Please address comments to:

Invasive Plant Program
Vegetation and Ecological Restoration
Division of Resources Management and Science
Yosemite National Park
P.O. Box 700
El Portal, CA 95318

Phone: Garrett Dickman (209) 379-3282
Email: garrett_dickman@nps.gov

For more information about invasive plants and their management in Yosemite, please visit:
<http://www.nps.gov/yose/naturescience/invasive-plants.htm>

CONTENTS

Introduction.....	3
review Process	3
Summary of 2017 Work	6
Prevention, Outreach, and Early Detection.....	6
Public outreach.....	6
Volunteer program	7
Equipment inspection.....	7
Weed-free sand and gravel.....	7
Early detection, rapid response	8
Priortization.....	9
Species Treatment summaries.....	9
Treatment effectiveness	11
2018 Work Plan.....	17
List of terms	17
Treatment plan for High-Priority species	18
Treatment plan for Medium-High priority species	20
Medium to Medium-Low Priority treatment species.....	22
Early detection and treatment Species	23
Early detection and treatment sites	24
Treatment Plan by General Location	25
Appendix A: 2018 Invasive Plant Early Detection Watch List	31
California Invasive Plant Council (Cal-IPC) Ratings	32
California Department of Food and Agriculture (CDFA) Noxious Weed Ratings	32
References.....	33

INTRODUCTION

The purpose of the Invasive Plant Program (IPP) is to protect Yosemite National Park's diverse natural and cultural resources from degradation by non-native invasive plants. Yosemite is just under three quarters of a million acres in size, which makes surveying for and treating invasive plants logistically difficult. The threat from invasive species is growing and new invasive plant species and populations are found and treated each year. Limited operational resources for invasive plant control make it critical that treatments are efficient and effective and guided by an annual strategic work plan.

Invasive plant management in Yosemite National Park is directed by the 2010 Invasive Plant Management Plan Update (2010 IPMP) and the 2008 Invasive Plant Management Plan (2008 IPMP). Both publications are available at:
http://www.nps.gov/yose/parkmgmt/invasive_docs.htm

Management actions are based upon integrated pest management (IPM) elements, which include prevention, inventory, prioritization, treatment, monitoring, research, education, and outreach. The IPM process includes manual, mechanical, biological, chemical and cultural treatment methods to ensure that the most effective tools are used to protect resources, while posing the least possible impact to people and the environment.

REVIEW PROCESS

All invasive plant management activities are under ongoing internal review by Yosemite's Division of Resources Management and Science as well as other park divisions. External consultation with stakeholders, such as American Indian tribes and groups, also occurs throughout the invasive plant management planning and implementation processes.

Each year, managers develop appropriate invasive plant treatment strategies for each infestation. The treatment method for a particular locality depends on the species, plant phenology (stage of a plant's life cycle), and the availability of methods known to be effective and permitted under the IPMP. A range of site-specific considerations are taken into account when selecting the appropriate treatment methods. Site-specific considerations may include, but are not limited to:

Location	Treatment
Wetland and riparian ecosystems (including the bed and banks of Wild and Scenic Rivers)	Treatment performed in consultation with wildlife ecologists where necessary. Most areas are treated using aquatic herbicides if mechanical methods are determined to be ineffective.
Terrestrial ecosystems	Herbicides may be used for high and medium-high priority species if other methods are determined to be ineffective.

Location	Treatment
Archeological sites	Control near archeological resources conducted in consultation with the Branch of Anthropology and American Indian tribes and groups.
American Indian traditional use areas	Control near traditional use areas carried out in consultation with the Branch of Anthropology and American Indian tribes and groups.
Designated wilderness	The minimum appropriate tool will be used to control invasive species. Herbicide use is allowed if it is determined to be the best tool following the programmatic minimum requirements analysis. Otherwise, manual or mechanical methods are used.
Private in-holdings	Outreach, assistance, and treatment with landowner's permission.
Concessionaire land assignments	Concessionaires are responsible for treatment of invasive plants. NPS staff coordinates with the concessionaire to treat high priority invasives following site-specific considerations.
Special status plant habitat	Control near special status plant populations conducted in consultation with botanists in the Branch of Vegetation and Ecological Restoration during planning stages.
Wildlife species of concern and associated habitat	Control near habitat for species of concern conducted in consultation with wildlife ecologists during planning stages.



FIGURE 1 TREATMENT OF VELVET GRASS AT NEVADA FALL

Yosemite National Park consults with seven traditionally associated American Indian tribes and groups to ensure there are no adverse effects to historic properties of cultural or religious significance including traditional use areas. Information sharing and project planning will continue in consultation with American Indian tribes and groups throughout the planning and implementation of the 2018 field season to ensure that concerns are properly addressed and that management recommendations are fully considered. Information sharing includes notifications, meetings and field visits, and this annual work plan, which outlines locations, approximate dates, and methods for invasive plant

management activities proposed for the 2018 season. In response to tribal comments and recommendations, treatment modifications may include using herbicide in lieu of mechanical treatments around archeological sites to avoid soil disturbance, or using mechanical rather than herbicide treatments in traditional gathering areas.

SUMMARY OF 2017 WORK

PREVENTION, OUTREACH, AND EARLY DETECTION

Yosemite focuses on five major early detection and outreach programs:

- **Public outreach**
- **Volunteer program**
- **Equipment inspection**
- **Weed-free sand and gravel**
- **Early detection, rapid response**

PUBLIC OUTREACH

Invasive plant managers communicate with visitors, local communities, and other land managers. The invasive plant website, <http://www.nps.gov/yose/naturescience/invasive-plants.htm> provides abundant information appropriate for both visitors and other land managers. Additionally, the invasive plant crew offers consultation and treatment assistance for park inholdings and park neighbors.



FIGURE 2 VOLUNTEERS REMOVING BULLTHISTLES IN YOSEMITE VALLEY

VOLUNTEER PROGRAM

Volunteers are an essential component of the Yosemite Invasive Plant Program (Figure 2). In 2017, 488 volunteers from 23 groups contributed 3,475 hours towards invasive plant control. Volunteers surveyed more than 90 acres and treated around 1.2 canopy acres of invasive plants such as bull thistle and dandelion. Every volunteer receives an overview of invasive plant management and training in the most effective treatment methods before participating.

EQUIPMENT INSPECTION



FIGURE 3 HEAVY EQUIPMENT INSPECTED TO ENSURE WEED SEEDS ARE NOT TRANSPORTED INTO THE PARK

The Invasive Plant Program collaborates with the Division of Facilities Management to inspect all incoming heavy equipment (Figure 3). Prior to these inspections, heavy equipment was a major source of invasive plant propagules. Now, most contractors fully comply with this program and few pieces of equipment are denied access to the park each year. In 2017, over 60 pieces of heavy equipment were inspected. These inspections remain an important and cost effective program to prevent the introduction of invasive plants.

WEED-FREE SAND AND GRAVEL

Non-native plants can be introduced by imported sand and gravel (aggregate). To prevent invasive plant introductions, resource managers inspect quarries for invasive plants and work with quarry operators to treat them before the material is brought to the park. In 2017 staff inspected three quarries involved with the weed free aggregate program.

EARLY DETECTION, RAPID RESPONSE

Invasive plant management has the highest probability of success when populations are found in the early stages of an infestation. Every year a population is left to expand unchecked; it becomes more difficult to control and has a greater impact to native plant communities. Additionally, the financial cost of treatment increases exponentially. As such, resource managers ensure that new populations of invasive plants are discovered early and treatment is performed soon thereafter. Invasive plant program personnel surveyed 2,403 acres of the park for invasive plants in 2017. Staff treated 128 unique species prioritized for eradication.



FIGURE 4 BIOLOGISTS COLLECT GPS DATA THAT IS CRITICAL FOR A SUCCESSFUL INVASIVE PLANT MANAGEMENT PROGRAM

Within the past two years, staff found three new non-native species to the park including salt cedar (*Tamarix ramosissima*) in the Grand Canyon of the Tuolumne, buffalobur nightshade (*Solanum rostratum*) at Badger Pass, and reed canary grass (*Phalaris arundinacea*) in Yosemite Valley. Salt cedar is highly invasive in riparian areas and is known for its ability to alter habitats. Reed canary grass is native to other parts of California, but is highly aggressive in riparian habitats.

Notable range extensions of invasive populations include medusahead (*Elymus caput-medusae*) barbed goatgrass (*Agilops truinclialis*) in Foresta. In 2017, isolated populations of Italian thistle were found in Yosemite Valley and near the Hetch Hetchy entrance station. Additionally, yellow star-thistle was found for the first time in the Wawona area in 2016 and at Eleanor Lake in 2017.

Ackerson Meadow, a new addition to the park, will continue to be surveyed extensively for novel invasive plant populations in 2018. In 2017, 5.6 gross infested acres of medusahead were mapped and treated.

PRIORTIZATION

Currently, 269 non-native plant taxa occur in Yosemite. While many of these non-native plants do not pose a threat to park resources, some non-native plants (also known as “transformer species”) have the potential to form monotypic stands, greatly altering resource availability, trophic structure, ecosystem productivity, and/or natural disturbance regimes (D'Antonio et al. 2004). Program managers used three main characteristics to determine the priority order for invasive plant control: 1) current impacts on park resources 2) potential threat on park resources and 3) feasibility of control. Program managers assigned a low-priority ranking to species that did not meet at least one of the following criteria:

- Present on the California Department of Food and Agriculture (CDFA) List of Noxious Weeds (Schoenig 2005)
- Present on the California Invasive Plant Council (Cal-IPC) list of Invasive Non-Native Plants that Threaten Wildlands in California (Cal-IPC 2006)
- Present on the U.S. Geological Survey (USGS) Alien Plant Species Threat Assessment for Yosemite (Gerlach et al. 2003)

Many of these low priority non-native plant species are restricted to disturbed areas such as road corridors, campgrounds and parking areas, and do not appear to be spreading into natural areas. Other low-priority species are so widespread within Yosemite and surrounding areas (e.g., some Mediterranean grasses) that control is not feasible.

SPECIES TREATMENT SUMMARIES

There are around 1,415 gross infested acres of non-native plants documented in the park. Over 260 acres were treated in 2017. As follows are the treatment summaries for high and medium-high priority species.

YELLOW STAR-THISTLE (*CENTAUREA SOLSTITIALIS*)

Each field season begins with the program’s most ambitious and challenging project—the treatment of yellow star-thistle in El Portal. This infestation grows in difficult terrain with steep slopes that require the use of ropes by treatment crews for fall protection. Park personnel treat infestations in cooperation with neighboring land owners, such as the USFS and private land owners. In 2017, crews treated 0.41 canopy acres of yellow star-thistle on NPS land. Invasive plant crews covered all previously known yellow star-thistle infestations within park boundaries and expanded treatment into new areas outside the park. After several years of treatment, Yellow star-thistle density has undergone drastic reductions since treatments began (Figures 6 & 8).

HIMALAYAN AND CUT-LEAF BLACKBERRY (*RUBUS ARMENIACUS* AND *R. LACINIATUS*)

Crews treated 3.16 canopy acres of non-native blackberry in 2017. By implementing effective control techniques, Yosemite has reduced the population in Yosemite Valley by 93% since 2009 (Figure 7).

Crews completed treatment of all accessible blackberry infestations in Yosemite Valley and Hetch Hetchy. Large treatments were completed in the Lake Eleanor area. Backpack sprayers were used to treat infestations in most areas but the “cut and dab” method was employed in some traditional use areas and around rare plant species (Figure 5).



FIGURE 5 INVASIVE PLANT PERSONNEL COMPLETE TREATMENT OF BLACK SPRINGS INFESTATIONS USING CUT AND DAB TECHNIQUES. PHOTOS FROM LEFT TO RIGHT ARE BEFORE TREATMENT, THE APPLICATION PROCESS AND AFTER REMOVAL

WALL HAWKWEED (*HIERACIUM MURORUM*)

Wall hawkweed was not known to occur in California prior to the discovery of this population in 2010. Wall hawkweed was found and treated in surveys conducted in 2017 at the Tacoya housing area and near the Majestic Yosemite Hotel in Yosemite Valley.

BULL THISTLE (*CIRSIUM VULGARE*)

Volunteers manually treated 1.58 canopy acres of bull thistle. Bull thistle is found in Yosemite Valley, Wawona, designated Wilderness, and in some recently burned areas. Crews also treated large, dense populations of bull thistle in the Mariposa Grove and over 9 canopy acres in the Meadow Fire footprint (Figures 8 & 9).

SPOTTED KNAPWEED (*CENTAUREA STOEBE*)

Crews conducted follow up surveys and treatment in an ongoing effort to extirpate spotted knapweed in Foresta. In 2014 surveyors found several large, previously unknown populations. These discoveries prompted managers to reevaluate their methods and begin

treatment of this species with aminopyralid in 2015. Herbicide treatments increase the effectiveness of control efforts by targeting small and difficult to see seedlings of invasive plants that surround larger individuals and by providing better control. In 2015, a single individual was found along the Mist Trail, one of the most heavily used trails in the park. Another individual was found in Yosemite Valley near the El Capitan Picnic Area in 2016. An individual was found by the NPS Warehouse building in 2017.

OXEYE DAISY (*LEUCANTHEMUM VULGARE*)

Crews treated 0.14 canopy acres in Big Meadow and Foresta with aminopyralid. Three individuals of oxeye daisy were found by the golf course in Wawona and one was found in residential Wawona.

VELVET GRASS (*HOLCUS LANATUS*)

Velvet grass infests hundreds of acres of Yosemite meadows. This year, Yosemite staff treated Velvet grass at Merced Lake with imazapyr. The isolated Merced Lake population is 13 miles from the nearest road, farther into the wilderness than any other high-priority invasive plant and 2000 feet higher than the closest population. Control efforts for Velvet grass increased in 2017 with 7.94 canopy acres of velvet grass treated at Hodgdon, Hetch Hetchy entrance station, and Yosemite Valley using glyphosate.

CHEATGRASS (*BROMUS TECTORUM*)

Cheatgrass is a major invader of the foothill woodlands and is spreading into new areas within the park. Park staff are collaborating with the U.S. Geologic Survey (USGS) on effectiveness studies for cheatgrass control.

In 2015, an infestation of cheatgrass was found and hand-pulled at Rodgers Lake, about 20 miles from the nearest road. The invasive plant program has begun treating isolated populations of this species above 7000 feet.

In 2017, Cheatgrass and other annual invasive grasses were treated in select areas in coordination with other projects. Annual invasive grasses were treated at restoration sites in Yosemite Valley and along roadsides in El Portal to reduce the potential for fire ignitions.

TREATMENT EFFECTIVENESS

TREATMENT HISTORY TRENDS

Yosemite invasive plant managers track the volume and location of herbicide use. Figures 6 and 7 show the herbicide volume of aminopyralid and glyphosate applied within Yosemite since the program began using herbicide in 2009. These are the two most commonly used herbicides.

The figures show for both Himalayan blackberry and yellow star-thistle the number of gallons of herbicide increased from 2009 to 2010 and began to decrease by 2012. This

decrease is attributed to treatment success over time, and further decline continues. The decline due to treatment success is also observed when examining the number of canopy acres treated over seven years (Figure 8). Canopy acres are the combined area of the individual plants without including space between plants. Note the vertical axes are different on all graphs as aminopyralid is a more concentrated formulation than glyphosate.

While the number of acres treated decreased from 2010 to 2012, the amount of area surveyed by invasive plant crews increased consistently from 2009 to 2015. The gross infested acres include the area between plants in an infestation and define the total area affected by an infestation (Figure 9). As treatments of Himalayan blackberry and yellow star-thistle are successful, there is more time available for other invasive plant treatments, illustrated by the increase of all other species treated from 2013 to 2015 (Figure 8).

At the peak of the Himalayan blackberry infestation, 130 canopy acres of Yosemite were infested, of which 100 acres were in the Merced River corridor. Today, we believe there are less than 6 canopy acres left in the Merced River corridor. Rigorous, comprehensive treatments have reduced the Himalayan blackberry population by 93% in six years.

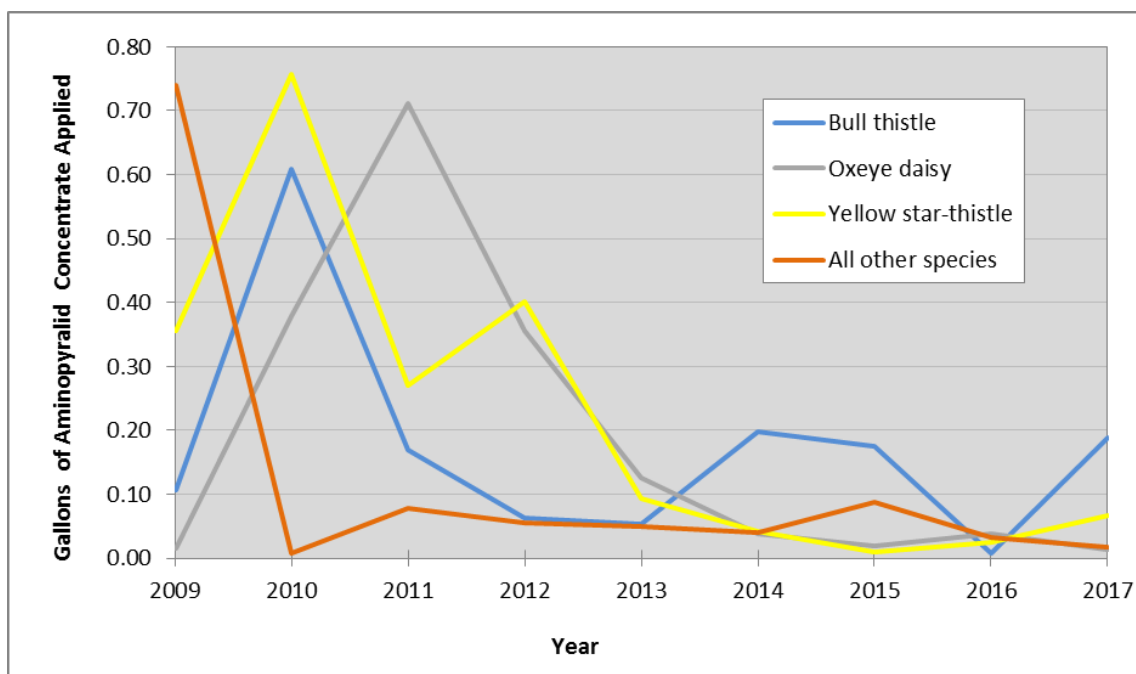


FIGURE 6 THE AMOUNT OF THE HERBICIDE AMINOPYRALID USE FROM 2009 TO 2017 IN YOSEMITE. AMINOPYRALID WAS USED PREDOMINANTLY ON YELLOW STAR THISTLE, BULL THISTLE, AND OXEYE DAISY. HIGH DOASGE WAS USED IN 2010 AND 2011 (ABOUT .75 GALLONS) AND THAT HAS DROPPED TO A LOW IN 2016 TO APPROXIMATELY .05 GALLONS

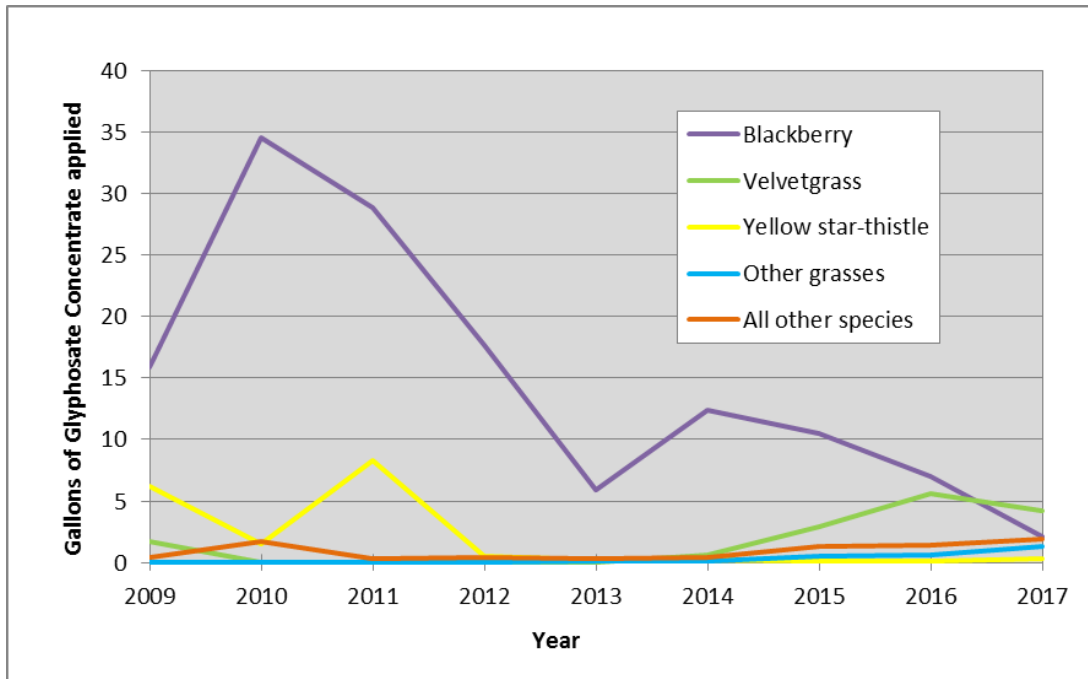


FIGURE 7 THE NUMBER OF GALLONS OF THE HERBICIDE GLYPHOSATE USED FROM 2009 TO 2017 IN YOSEMITE. GLYPHOSATE IS USED PREDOMINANTLY ON HIMALAYAN AND CUT-LEAVED BLACKBERRY WITH PEAK APPLICATION OF THE HERBICIDE IN 2010 WITH ABOUT 35 GALLONS. VELVET GRASS HAS BEEN TARGETED FOR TREATMENT WITHIN THE LAST TWO YEARS SO THE AMOUNT APPLIED RISES FROM ZERO GALLONS TO A RECENT HIGH OF JUST OVER 5 GALLONS IN 2016. THE DIP IN ACRES OF BLACKBERRY TREATED IN 2013 IS DUE TO A REDUCTION IN THE NUMBER OF FIELD CREW TREATMENT HOURS AS STAFF WAS DIVERTED BY THE RIM FIRE AND GOVERNMENT SHUTDOWN.

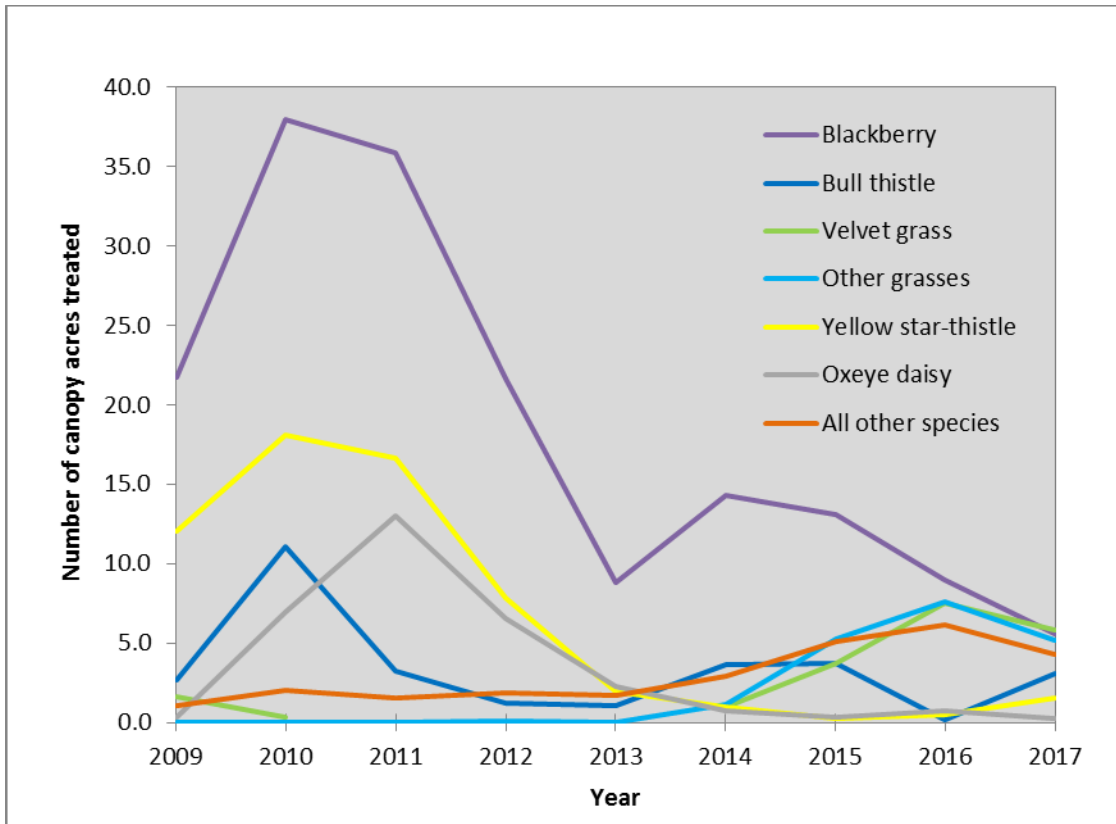


FIGURE 8 THE NUMBER OF CANOPY ACRES TREATED FROM 2009 TO 2017.

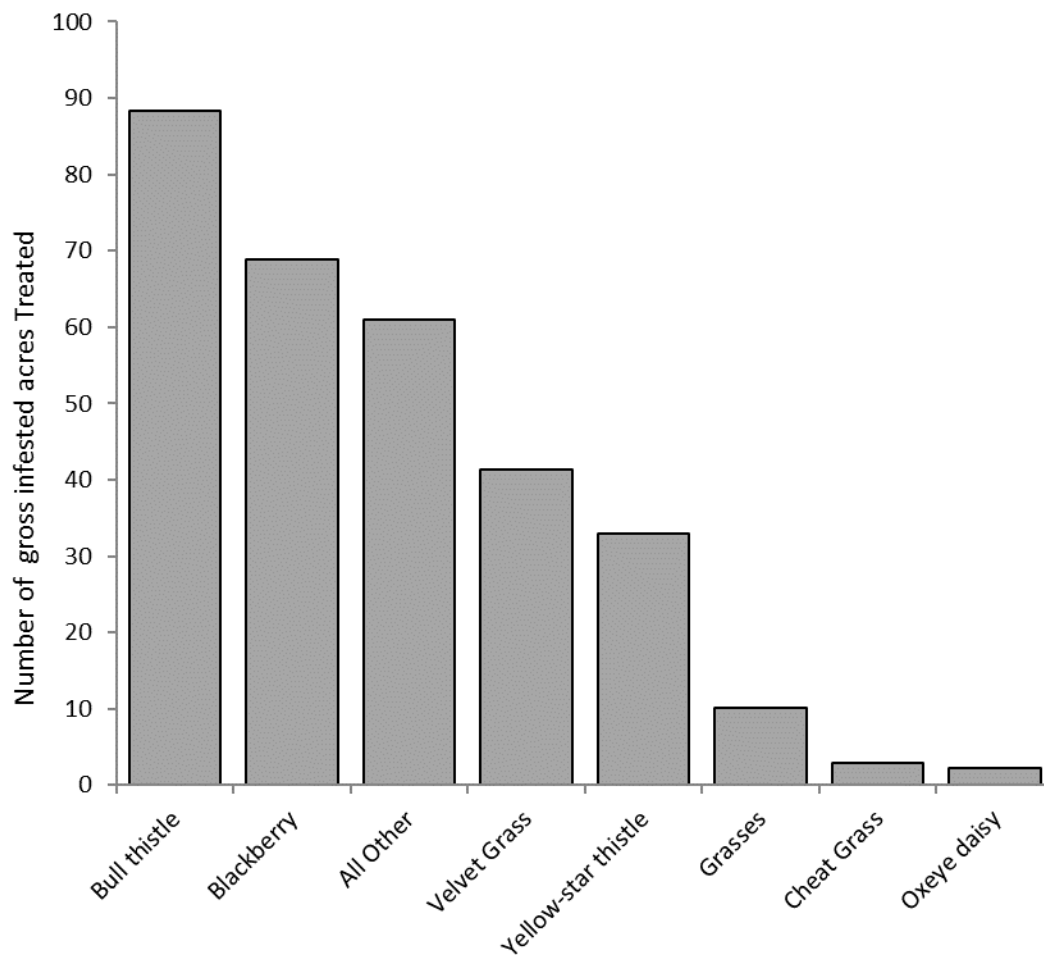


FIGURE 9 THE NUMBER OF GROSS INFESTED ACRES TREATED IN 2017 FOR BULL THISTLE, BLACKBERRY, ALL OTHER NON-GRASS SPECIES (E.G. DANDELION, EARLY DETECTION SPECIES), VELVET GRASS, YELLOW STAR THISTLE, ALL GRASSES (EXCLUDING VELVET GRASS AND CHEAT GRASS), CHEAT GRASS AND OXEYE DAISY. GROSS INFESTED ACRES INDICATE THE POPULATION SIZE AS IT INCLUDES ALL AREA BETWEEN PLANTS.

MANUAL TREATMENT VERSUS HERBICIDE TREATMENT OF BLACKBERRY

Prior to 2009, Himalayan blackberry was manually and mechanically treated and only in easily accessible sites in Yosemite Valley (Figure 10). In rocky and remote terrain, it is not possible to manually remove blackberry roots effectively. Manual methods involve heavy soil disturbance and major impacts to native vegetation and underground cultural resources. After years of exhaustive treatments and retreatments of blackberry in Yosemite Valley, these sites were often recolonized by new invasive plants, such as bull thistle and velvet grass. Trial plots that compare herbicide use and manual hand removal show herbicide treatments foster better and more rapid native species recovery.



FIGURE 10 BEFORE (TOP) AND AFTER (BOTTOM) PHOTOPOINTS OF MECHANICAL TREATMENTS (LEFT) AND HERBICIDE TREATMENTS (RIGHT) ON BLACKBERRY. AFTER (BOTTOM) PHOTOS WERE TAKEN ONE YEAR AFTER TREATMENT.

2018 WORK PLAN

This plan describes the methods and locations of control actions for high and medium-high priority invasive species and all planned treatments. This plan consists of 1) planning maps (in a separate document) 2) treatment plans for managed species at each priority level (high, medium-high, medium to low priority species) 3) early detection species 4) early detection sites and 5) treatment plans by general locations.

New invasive plant species and new populations of high priority plants are found each year. The most effective way to protect the park from new invasions is through rapid response to these early detections. Because of this, on a limited basis, crews may apply treatments that are not explicitly described in this document and on the maps. Some plants survive initial treatment, so crews will monitor previously treated sites and retreat as needed.

DETAILED PLANNING MAPS

This plan includes a set of maps that provide site-specific treatment details to park staff and the public. These maps are critical to help guide the field crews' decision-making. The maps display invasive plant infestation data collected in the field since 1995. Invasive species often co-occur, showing up on a map as a feature within a feature. The treated area of one species' infestation can overlay the larger infestation of another species.

LIST OF TERMS

TREATMENT TECHNIQUES

SPOT SPRAY	Targeted application of herbicide focused only on the foliage of the target plant species using a backpack sprayer or a truck-mounted sprayer. Targeted applications reduce drift and result in minimal impact to non-target plants.
FRILL CUT	Used on trees or large shrubs; a diagonal cut into the bark is made prior to herbicide application to aid delivery of herbicide into the target plant.
CUT STUMP	Used on trees and shrubs; a tree is cut near ground level before herbicide is applied directly to the stump of the target plant.
HAND-PULL	Removal of target plant biomass, including the roots, by hand.
LOP AND GRUB	Above ground plant is cut with loppers and then the (often deeper) root system is dug out; very time intensive.
SHOVEL-SHEAR	Plant is severed a couple inches under the ground surface using a shovel; some root material remains.

DEAD-HEAD	Flowers and seeds are removed to prevent spread by seed.
CUT AND DAB	Plants are cut a few inches from ground and herbicide is applied to the stump.
MOW	Above ground plant material is cut using hand or power tools. This method removes reproductive parts before they mature, but leaves the target plant alive.

MONITORING ACTIVITIES

SURVEY	A systematic search for target plants.
GRID SURVEY	A line of people collectively search for target plants and increase survey effectiveness.
MAP	To document infestations; most often using GPS units.
GPS	Global Positioning System; use of satellite technology to pinpoint location; used to map infestations with handheld units.
MONITOR	All activities that examine results of management actions; for example, observation of a site after treatment to document the outcome of that treatment.
PILOT STUDY	A quantitative study to assess effectiveness of a new treatment.

TREATMENT PLAN FOR HIGH-PRIORITY SPECIES

CHEATGRASS (BROMUS TECTORUM)

This plant is widespread in Yosemite and is extremely difficult to control. The IPP targets roadside populations for fire prevention in the Wildland Urban Interface and some dense populations prior to restoration efforts. Field staff will continue to document its distribution. In order to slow its spread into wilderness and high elevation areas, some infestations along the species' range limits will be targeted. Areas around restoration sites will be treated for cheatgrass in an attempt to limit its introduction into restored areas. Many roadsides will be treated for annual grasses to reduce flashy roadside fire fuels that increase the chance of a wildland fire ignition. Post emergent treatments of cheatgrass will be conducted with glyphosate in spring prior to seed set. In fall cheatgrass will be treated pre-emergently using rimsulfuron.

ITALIAN THISTLE (CARDUUS PYCNOCEPHALUS)

This California-listed noxious weed has several populations within Yosemite's boundary, in El Portal, the Mariposa Grove, Yosemite Valley, and near the Hetch Hetchy entrance station. Large infestations occur within 100 meters of the park border in El Portal. Potential habitat

will be surveyed in surrounding areas and known infestations will be resurveyed and treated with aminopyralid. The aggressive nature and short growing season of Italian thistle makes it one of Yosemite's most threatening invasive plants.

SPOTTED KNAPWEED (*CENTAUREA STOEBE*)

Since its accidental introduction to Foresta in 1990, crews have repeatedly hand-pulled spotted knapweed with the goal of eradicating it from Yosemite. Previously infested areas will be resurveyed in 2018 and individual plants will be treated with aminopyralid.

YELLOW STAR-THISTLE (*CENTAUREA SOLSTITIALIS*)

Extensive grid surveys targeting yellow star-thistle occur annually in El Portal. Aminopyralid is applied to the plants in spring. Plants may be spot sprayed with glyphosate later in the season. Disjunct populations and individuals found along Big Oak Flat Road and near Hetch Hetchy will continue to be monitored to prevent spread to higher elevations. New populations at McCauley Ranch and Wawona will be surveyed and treated.

RUSH SKELETONWEED (*CHONDRILLA JUNCEA*)

This highly aggressive invasive plant was discovered in Yosemite in 2013 along El Portal Road just below Yosemite Valley. Repeated herbicide applications of aminopyralid will be used to control the existing populations and areas nearby will continue to be surveyed.

BULL THISTLE (*CIRSIIUM VULGARE*)

Bull thistle is presently the most widespread high-priority invasive plant in Yosemite. The main thrust of bull thistle treatments will be conducted by volunteer groups using manual methods. The invasive crew will conduct targeted herbicide treatments of high density populations in Yosemite Valley, the Mariposa Grove, and within recent fire perimeters.

MEDUSAHEAD (*ELYMUS CAPUT-MEDUSAE*)

Medusahead is a highly invasive grass that reduces forage quality and increases fire return intervals. Three small populations were found in Foresta in 2014, and one larger infestation at the Crane Flat Fire Lookout and Helibase. Another large population was found in and treated in Foresta along the Old Coulterville Road in 2015. All populations were treated manually upon their discovery, and treated aggressively with applications of glyphosate and rimsulfuron in the past three years. New medusahead populations were surveyed and treated in Ackerson Meadow. Treatments with both glyphosate and rimsulfuron will continue into the future.

BROOM SPECIES (*GENISTA MONSPESSULANA*, *CYTISUS SCOPARIUS*, AND *CYTISUS STRIATUS*)

All broom species (*Genista* spp. and *Cytisus* spp.) present within Yosemite are known to be highly invasive. These plants were introduced to residential areas in Yosemite as ornamentals and have spread quickly. Crews will treat French broom (*Genista*

monspessulana) on NPS land with aminopyralid. All known Scotchbroom (*Cytisus scorpiarius*) populations in treated in Wawona will be monitored and retreated as needed.

VELVET GRASS (*HOLCUS LANATUS*)

Velvet grass infestations will be treated with a combination of manual treatment by volunteers and crew applications of glyphosate until populations have been successfully eliminated. Treatments will focus on small populations within intact native plant communities, where eradication is feasible, such as those at Merced Lake, Lake Vernon, and Sunrise Creek. Small populations found in the wilderness, along roads and trails, or anywhere with a high likelihood of dispersal into natural habitats will also be a main target. Populations at Hetch Hetchy Entrance station, Hodgdon Meadows, Royal Arches Meadow and Miguel Meadows will be treated with glyphosate in 2018. Yosemite Valley populations will be mapped and potential future treatments prioritized.

HIMALAYAN AND CUT-LEAF BLACKBERRY (*RUBUS ARMENIACUS* AND *R. LACINIATUS*)

Himalayan blackberry constitutes the majority of invasive blackberry within Yosemite, but cut-leaf blackberry has also proven to be an aggressive invader. The main treatment method is glyphosate applied from backpack sprayers. Invasive plant crews will treat blackberry from late July-November. Crews may cut and dab populations located near special status plants, important cultural sites, or water.

TREATMENT PLAN FOR MEDIUM-HIGH PRIORITY SPECIES

GOATGRASS (*AEGILOPS CYLINDRICA*, *A. TRIUNCIALIS*)

Two species of goatgrass were found in 2012 and 2013. These grasses have caused considerable ecological damage in rangelands throughout California and now threaten grasslands along the western border of Yosemite. *A. triuncialis* has been treated with rimsulfuron and glyphosate the past three years. *A. cylindrica* has been mowed annually by NPS fire personnel since its discovery in 2012 as part of a fuels reduction program. Mowing has prevented this grass from spreading, but has not shown a visible reduction in population size. In 2017, *A. cylindrica* was treated with glyphosate in early spring followed by a fall treatment of preemergent rimsulfuron.

TREE-OF-HEAVEN (*AILANTHUS ALTISSIMA*)

Known populations exist in El Portal and Yosemite Valley. Crews will cut stump, basal bark, or spray foliage of small plants as appropriate. In El Portal, where many plants are located near homes, NPS crews will be available to help homeowners eradicate this species.

GIANT REED (*ARUNDO DONAX*)

Although giant reed is a widespread problem in California, there are only two known populations in Yosemite, in residential areas of El Portal. Crews treated this population with glyphosate from 2010 to 2013 and manually treated in subsequent years. *Arundo* will continue to be monitored and retreated annually until these populations are extirpated.

SMOOTH BROME (*BROMUS INERMIS*)

Smooth brome currently occupies a canopy acres within Yosemite, and occurs almost entirely as monotypic stands. Smooth brome occurs sporadically in high elevation locations along Tioga Road and will be treated in 2018. All high elevation populations will be treated with glyphosate. Dense infestations occur throughout Yosemite Valley.

HOPS (*HUMULUS LUPULUS*)

Hops are currently known to infest at least 3.4 acres in El Portal, Wawona, Carlon and several sites in Yosemite Valley. Populations treated in 2017 will be monitored and treated as needed. The remaining hops populations will be treated with imazapyr in 2018 as time allows.

WALL HAWKWEED (*HIERACIUM MURORUM*)

Wall hawkweed is a high priority early detection species with only two known populations within the park. Treatments with aminopyralid have been conducted and will continue into the future.

KLAMATHWEED (*HYPERICUM PERFORATUM*)

Infestations of Klamathweed will be treated with aminopyralid or glyphosate. Treatments will be concentrated along transportation corridors and in isolated occurrences.

OXEYE DAISY (*LEUCANTHEMUM VULGARE*)

The preferred treatment method is to spot spray with aminopyralid. In 2014 populations were discovered in Cooks Meadow, and in a fire suppression hand line near Harden Lake. These sites, along with other disjunct populations and populations found along transportation corridors will be treated.

DALMATIAN TOADFLAX (*LINARIA DALMATICA*)

Dalmatian toadflax is escaping cultivation in one location in Yosemite West. This is a highly aggressive and difficult to control invader. It has waxy leaves and an extensive root system making both manual and herbicide treatment less effective. Treatment will require cooperation of the land owner. It was not treated in 2017.

BLACK LOCUST (*ROBINIA PSEUDOACACIA*)

Yosemite Valley black locust populations are spreading and have been found as far downriver as the Rostrum. Many populations have been treated, and will be monitored and retreated as needed. Newly discovered populations will be treated with cut stump treatments of glyphosate or triclopyr. Basal bark applications of triclopyr or foliar treatments of glyphosate will be used on small individuals.

JOHNSON GRASS (*SORGHUM HALEPENSE*)

Johnson grass has been observed in El Portal, Yosemite Valley, and along Wawona Road. Populations remain small and isolated, so eradication is possible. Due to a deep underground root system, this plant does not respond to mechanical treatments so all infestations will be treated with foliar applications of imazapyr.

DANDELION (TARAXACUM OFFICINALE)

Dandelion is a medium-high priority species above 7,000 and a low priority below 7,000 feet. Populations have been observed on the USFS side of Mt. Dana, along the Mono pass trail, in pullouts and trailheads along the Tioga Road, in Tuolumne Meadows, and in numerous subalpine meadows throughout the wilderness. Dandelion populations are treated manually or with aminopyralid above 7,000 feet to protect alpine communities. In the Andes Mountains of South America, an analog of the Sierra Nevada, dandelion has been shown to take over many mountain meadows. Below 7,000 feet, dandelion does not appear aggressive enough to merit treatment.

MEDIUM TO MEDIUM-LOW PRIORITY TREATMENT SPECIES

Most medium and medium-low priority species, both in the front country and at high elevation in the back country, are treated manually by staff and volunteers as they are encountered. Small dense populations might be targeted for herbicide application on a site by site basis. Volunteers help the invasive plant program manage a greater variety of species each year by manually removing many infestations that would otherwise go untreated (Table 1)

TABLE 1 THESE NON-NATIVE SPECIES ARE MANUALLY TREATED WHEN ENCOUNTERED BY CREWS AND VOLUNTEERS

Species
Black mustard (<i>Brassica nigra</i>)
Field mustard (<i>Brassica rapa</i>)
Tocolote (<i>Centaurea melitensis</i>)
Foxglove (<i>Digitalis purpurea</i>)
Shortpod mustard (<i>Hirschfeldia incana</i>)
White sweet clover
Yellow sweet clover (<i>Melilotus</i> spp.)
Spearmint (<i>Mentha spicata</i> var. <i>spicata</i>)
Many-flowered tobacco (<i>Nicotiana acuminata</i> var. <i>acuminata</i>)
London rocket (<i>Sisymbrium irio</i>)
Yellow salsify (<i>Tragopogon dubius</i>)
Common mullein (<i>Verbascum thapsus</i>)

EARLY DETECTION AND TREATMENT SPECIES

TABLE 2. THESE NON-NATIVE SPECIES HAVE SMALL POPULATIONS AND ARE PRESENT ONLY IN A FEW LOCATIONS. ERADICATION IS HIGHLY DESIRABLE. TREATMENTS OF EARLY DETECTION SPECIES WILL INCLUDE HAND-PULLING OR HERBICIDE IF SPECIES ARE NOT EFFECTIVELY CONTROLLED WITH MANUAL METHODS.

Species	Location
Jointed goatgrass (<i>Aegilops cylindrica</i>)	Rancheria
Barbed goatgrass (<i>Aegilops triuncialis</i>)	Foresta
Common ragweed (<i>Ambrosia acanthicarpa</i>)	Valley Stables, Wawona Ranger Station
Redroot pigweed (<i>Amaranthus retroflexus</i>)	Yosemite Lodge
Common tarweed (<i>Centromadia pungens</i>)	Henness Ridge
Rush skeletonweed (<i>Chondrilla juncea</i>)	El Portal Road
Poison hemlock (<i>Conium maculatum</i>)	Badger Pass
Portuguese broom (<i>Cytisus striatus</i>)	Old El Portal
Queen Anne's Lace (<i>Daucus carota</i>)	Rancheria
Dragonhead mint (<i>Dracocephalum parviflorum</i>)	Tuolumne Horse Campground
Mexican tea (<i>Dysphania ambrosioides</i>)	Old El Portal, Rancheria
Medusahead (<i>Elymus caput-medusae</i>)	Foresta, Crane Flat Helibase, Ackerson Meadow
Broadleaf helleborine (<i>Epipactis helleborine</i>)	Ahwahnee Meadow, Cook's Meadow
Caper spurge (<i>Euphorbia lathyris</i>)	Old El Portal
Wall hawkweed (<i>Hieracium murorum</i>)	Tacoya Housing, Majestic Yosemite Hotel
Morning glory (<i>Ipomoea purpurea</i>)	Upper Pines Campground
Fluellin (<i>Kickxia spuria</i>)	NPS warehouse
Perennial pepperweed (<i>Lepidium latifolium</i>)	Foresta
Clasping pepperweed (<i>Lepidium perfoliatum</i>)	Tuolumne concession horse stables
Dalmatian toadflax (<i>Linaria dalmatica</i>)	Yosemite West
Hyssop loosestrife (<i>Lythrum hyssopifolia</i>)	Old El Portal
Alfalfa (<i>Medicago sativa</i>)	Tuolumne Horse Campground
Tree tobacco (<i>Nicotiana glauca</i>)	Old El Portal
Dallisgrass (<i>Paspalum dilatatum</i>)	Rancheria
Reed canary grass (<i>Phalaris arundinacea</i>)	Sentinel Meadow
American pokeweed (<i>Phytolacca americana</i>)	Old El Portal
Creeping buttercup (<i>Ranunculus repens</i>)	Wawona golf course
Russian thistle (<i>Salsola tragus</i>)	Ahwahnee Meadow, Sentinel Meadow
Shepherd's needle (<i>Scandix pecten-veneris</i>)	Old El Portal
Milk thistle (<i>Silybum marianum</i>)	Foresta, Incline Rd.
Indian hedge mustard (<i>Sisymbrium orientale</i>)	El Portal
Buffalobur nightshade (<i>Solanum rostratum</i>)	Badger Pass
Cutleaf nightshade (<i>Solanum triflorum</i>)	Valley stables, Curry Village
Johnson grass (<i>Sorghum halepense</i>)	Old El Portal, Rancheria, North Pines CG
Corn spurry (<i>Spergula arvensis</i>)	Tuolumne Horse Campground
Salt cedar (<i>Tamarix ramosissima</i>)	Grand Canyon of the Tuolumne
Fan weed (<i>Thlaspi arvense</i>)	Bridalveil Horse Campground
Crimson clover (<i>Trifolium incarnatum</i>)	Old El Portal
Seashore vervain (<i>Verbena litoralis</i>)	Rancheria

EARLY DETECTION AND TREATMENT SITES

Invasive plants require both propagules (seeds or rhizomes) and a vector (a person, piece of equipment, etc.) in order to spread and establish in new locations. Areas with both a high probability of species introduction and have high traffic to other areas of the park are the highest priority for invasives early detection surveys and treatments.

Aggregate and soil piles are hot spots for invasive plant infestation. Some park operations require material, such as sand and gravel, to be brought in from outside Yosemite. The material is often staged before being distributed and used in multiple locations throughout the park. A list of target early detection and treatment sites can be found in Table 3. The invasive plant program will survey all early detection and treatment sites.



FIGURE 11 CONTAMINATED GRAVEL PILE HOSTING ITALIAN THISTLE

TABLE 3 LIST OF EARLY DETECTION AND TREATMENT SITES.

Crane Flat soil piles	Valley woodlot
El Portal woodlot	Wawona helispot
Foresta woodlot	Wawona horse camp
Gaylor pit	Wawona soil pile
Hetchy soil piles	May Lake pit
Hetchy stables	Tuolumne stables
Bridalveil horse camp	Valley stables
Tuolumne horse camp	South landing

TREATMENT PLAN BY GENERAL LOCATION

EL PORTAL TO YOSEMITE VALLEY (MAPS 1.0-1.4, 1.6)

Species	Timing	Treatments
Yellow star-thistle	March-July	Spot spray (aminopyralid, glyphosate)
Jointed goatgrass	May, November	Spot spray (glyphosate, rimsulfuron)
Blackberry	August-October	Spot spray (glyphosate, imazapyr)
Black locust	April-October	Spot spray/Frill or cut stump (glyphosate, imazapyr)
French broom	May-July	Manual removal/Spot spray (aminopyralid)
Italian thistle	March-April	Spot spray (glyphosate, aminopyralid)
Giant reed	July	Manual removal/Spot spray (glyphosate)
Tree-of-heaven	October-November	Spot spray/Frill or cut stump (glyphosate, triclopyr)
Hops	March-July	Spot spray (triclopyr, imazapyr)
Johnson grass	March-November	Spot spray (imazapyr)
Perennial sweet pea	June	Spot spray (aminopyralid)
Rush skeletonweed	March-October	Spot spray (aminopyralid)

Yellow star-thistle is the greatest management concern in El Portal. The crew will survey all of El Portal and treat infestations by herbicide application. **Blackberry** treatment was initiated in many areas in El Portal in 2011 and will continue into future years. The IPP will notify residences prior to treatment in their yards. Crews will also continue to map and work with residents to remove remaining invasive species in the residential area such as **tree-of-heaven** and **French broom**. Numerous early detection species are present throughout El Portal, and are targeted for treatments with the goal of eradication.

FORESTA & BIG MEADOW (MAPS 1.4-1.5)

Species	Timing	Treatments
Spotted knapweed	May-August	Grid survey/hand-pull or spot spray (aminopyralid)
Yellow star-thistle	May-June	Grid survey/hand-pull or spot spray (aminopyralid)
Medusahead	April-May & September-November	Manual removal/Spot spray (glyphosate, rimsulfuron)
Blackberry	August-October	Spot spray (glyphosate, imazapyr)
Velvet grass	June-July Spring-fall	Herbicide study, spot spray (glyphosate, imazapyr)
Perennial pepperweed	June-August	Monitor, spot spray (glyphosate)
Italian thistle	April-May	Manual removal; spot spray (aminopyralid)

Species	Timing	Treatments
Oxeye daisy	June-August	Spot spray (aminopyralid)
Klamathweed	June-August	Spot spray (aminopyralid, glyphosate)

NPS crews have almost eradicated **spotted knapweed** (Figure 15), **perennial pepperweed**, **Italian thistle**, **milk thistle** and **yellow star-thistle** from the Foresta area. Crews will continue surveying for these species and will document and treat any plants encountered. Crews will remap and spray **Himalayan blackberry**, most of which is at McCauley Ranch. Treatment will continue on **oxeye daisy** infestations throughout the Big Meadow area. Crews will hand-pull or shovel-shear **bull thistle** and spray larger populations with herbicide.

YOSEMITE VALLEY (MAPS 2.0-2.6)

Species	Timing	Treatments
Blackberry	August-October	Spot spray or cut and dab in traditional use areas (glyphosate, imazapyr)
Velvet grass	May-July & September-October	Manual removal with volunteers or spot spray (glyphosate)
Bull thistle	May-August	Shovel-shear, spot spray (aminopyralid)
Oxeye daisy	June-July	Map; spot spray (aminopyralid)
Klamathweed	July-August	Map; spot spray (aminopyralid, glyphosate)
Black locust	August-October	Cut stump, spot spray (glyphosate, triclopyr)
Hops	March-June	Spot spray (imazapyr)
Perennial sweet pea	June-July	Map new populations; spot spray (aminopyralid)
Russian thistle	May-August	Hand-pull, spot spray (glyphosate)
Wall hawkweed	June-August	Spot spray (aminopyralid)
Smooth brome, downy brome	June-August	Spot spray (glyphosate, rimsulfuron)

Herbicide treatment of **blackberry** in Yosemite Valley will continue in 2018. Volunteers will manually treat **bull thistle** in all meadows within Yosemite Valley after July 15th to avoid ground nesting birds. **Black locust** will be mapped and treated using the cut stump or basal bark treatment methods. All **hops** infestations will be treated with imazapyr. All early detection weed species will be monitored and treated as necessary. **Velvet grass** will be thoroughly mapped and prioritized for possible future treatments. Crews will continue to monitor, map, and treat a growing population of **biennial wild lettuce** in Tenaya Canyon.

WAWONA AND HIGHWAY 41 (MAPS 3.0-3.5)

Species	Timing	Treatments
Blackberry	August-October	Spot spray (glyphosate, imazapyr)
Velvet grass	May-July	Spot spray (glyphosate)
Hops	March-July	Spot spray (imazapyr, triclopyr)
Klamathweed	June-August	Spot spray (aminopyralid)
Bull thistle	May-August	Shovel-shear, spot spray (aminopyralid)
Cheatgrass	April-June	Control (glyphosate) of isolated populations (incl. Henness Ridge)
Foxglove	June-July	Hand-pull, spot spray (glyphosate)
Perennial sweet pea	June-July	Map, spot spray (aminopyralid)
Rose campion	May-July	Hand-pull
Creeping buttercup	July-September	Hand-pull, spot spray (glyphosate)
Dalmatian toadflax	May-September	Spot spray (chlorsulfuron, imazapyr)
Broom species	May-July	Manual removal, cut stump (triclopyr)

The invasive plant crew will treat infestations of **blackberry** with glyphosate and work cooperatively with the concessionaire to treat the infestations near the Wawona golf course. The only known Yosemite population of **creeping buttercup** occurs along a creek adjacent to the golf course and will be retreated using an aquatic formulation of glyphosate. All non-landscape **hops** will be treated with imazapyr.

Velvet grass persists around the perimeter of Wawona Meadow and has a wide distribution in the area. Crews will treat velvet grass in key areas to reduce the risk of further spread, such as populations along the Chilnualna Falls trail and along the South Fork of the Merced River. Field staff will survey for new infestations in the Wawona Meadow restoration site and other areas.

Residential areas in Wawona are particularly diverse with non-native plants. Small populations of **French broom** and **Scotch broom** exist on private land within the northern residential area. To address the invasive plants on private property, the IPP will continue outreach efforts, seeking cooperation and agreements to treat plants on private land.

Cheatgrass occurs at Henness Ridge (not shown in maps) where few other non-native plants are present. Crews will treat cheatgrass with glyphosate or rimsulfuron during the early season. **Dalmatian toadflax** was found escaping cultivation in Yosemite West. The IPP will work with the homeowner to treat this species with herbicide. If time allows, crews will treat isolated patches of **intermediate wheatgrass** along Wawona Road.

MARIPOSA GROVE (MAP 3.6)

Species	Timing	Treatments
Blackberry	August-October	Spot spray (glyphosate)
Bull thistle	May-August	Hand-pull, shovel-shear, spot spray (aminopyralid)
Common mullein	May-September	Hand-pull
Foxglove	May-September	Hand-pull
Italian thistle	May-June	Spot spray (aminopyralid)
Velvet grass	May-June & September-October	Spot spray twice yearly (glyphosate, imazapyr)

Invasive plant populations in the Mariposa Grove are a concern because of their potential to spread into more remote wilderness locations and their ability to compete against the numerous special status plant species there. Large infestations of **bull thistle** occur throughout the grove and were treated by volunteers from 2012 to 2017. Park staff will treat dense populations with aminopyralid while smaller more isolated patches will be manually treated with volunteer crews. Any non-native **blackberry** within the Mariposa Grove will be sprayed with glyphosate. **Velvet grass** within the grove will be mapped and treated with glyphosate.

NORTHERN YOSEMITE/RIM FIRE (MAPS 4.1, 4.7-4.9)

Species	Timing	Treatments
Blackberry	August-October	Spot spray (glyphosate)
Velvet grass	May-July & September-October	Survey and map, hand-pull, shovel-shear, spot spray (glyphosate, imazapyr)
Bull thistle	April-October	Spot spray (aminopyralid)
Klamathweed	June-August	Spot spray (aminopyralid)

Blackberry grows in dense patches along creeks below Lake Eleanor. These populations will continue to be monitored and treated in 2018. Crews will also treat **velvet grass** in mid-elevation meadows and monitor treatment success quantitatively.

POOPENAUT VALLEY TO O'SHAUGHNESSY DAM (MAPS 4.2-4.4)

Species	Timing	Treatments
Blackberry	August-October	Spot spray (glyphosate)
Velvet grass	May-July	Survey and map, hand-pull, shovel-shear, spot spray (glyphosate, imazapyr)

Species	Timing	Treatments
Bull thistle	April-October	Spot spray (aminopyralid)
Klamathweed	June-August	Spot spray (aminopyralid)
Yellow star-thistle	April-August	Survey, spot spray (aminopyralid)

Blackberry grows along the Tuolumne River below Hetch-Hetchy. Additional surveys are needed to gain a complete understanding of the infestation in the most remote areas. Treatment of the lower Tuolumne and the populations just below O'Shaughnessy Dam are among the most complex projects undertaken by the IPP. Terrain is difficult and requires technical rope work to access.

Crews will continue to treat the remainder of klamathweed infestations along the Hetch Hetchy access road from Mather. **Velvet grass** was treated at the entrance station with new formulations of herbicide and treatment will continue. Small, scattered populations of **bull thistle** are treated by hand-pulling and shovel-shearing. Aminopyralid will be used if large populations are discovered. Crews will monitor and treat any plants found at a staging area near the Hetch Hetchy stables where yellow star-thistle, Italian thistle, and French broom have been found.

TUOLUMNE MEADOWS (MAPS 5.3-5.4)

Species	Timing	Treatments
Cheatgrass	May-June	Spot spray (glyphosate)
Dandelion	June-September	Spot spray (aminopyralid)
Smooth brome	June-September	Spot spray (glyphosate)
Clasping pepperweed	May-September	Hand-pull or spot spray (glyphosate, rimsulfuron)

In 2013, and 2016 the Invasive Plant Program conducted intensive surveys of the Tuolumne Meadows region. Crews resurveyed and treated dandelion, smooth brome and clasping pepperweed. **Dandelion** is by far the most widespread weed in Tuolumne and has undergone chemical treatment since 2011 in select areas. Most sites will be treated manually to avoid impacts to amphibians. Early detection species such as high elevation **smooth brome** and **clasping pepperweed** will be retreated to work towards the goal of local extirpation. Two small and isolated patches of cheatgrass were found for the first time in Tuolumne in 2013 and will undergo treatment in late spring/early summer to prevent further spread.

The highest amount of invasive plant diversity was found at Tuolumne stock use locations. At the Tuolumne horse campground, 24 different non-native plants were documented. This area can act as a propagule source for stock to transport invasive plants into the wilderness and therefore be treated.

WILDERNESS AREAS (MAPS 2.7-2.9, 4.1, 4.6-4.7, 5.1-5.2, 5.5)

Species	Timing	Treatments
Blackberry	June-October	Spot spray or cut-and-dab (glyphosate, imazapyr)
Velvet grass	June-October	Hand-pull, or spot spray (glyphosate)
Bull thistle	June-September	Hand-pull, shovel-shear
Yellow salsify	June-September	Inflorescence removal, hand-pull
Common mullein	June-September	Hand-pull
Prickly lettuce	June-September	Hand-pull
Cheatgrass	June-September	Map, spot spray (rimsulfuron, glyphosate)
Dandelion	June-September	hand-pull or spot spray (aminopyralid)

Control of invasive plant populations in designated wilderness areas is a high priority. In the past, crews treated **blackberry** populations in remote locations by hand-pulling. Where infestations have not been eliminated with manual methods, crews will apply glyphosate.

Bull thistle is the most abundant invasive species in Wilderness and has been removed manually or mechanically for decades.

An infestation of **velvet grass** was found at Merced Lake, 13 miles from the nearest road. As the most troubling and aggressive weed population within the Yosemite Wilderness, this infestation will be treated to prevent further spread into the backcountry. NPS crews and volunteers will continue to manually treat several other invasive species such as **common mullein** and **prickly lettuce** (*Lactuca serriola*) in remote Wilderness locations. At the present time, **dandelion** is a greater threat to subalpine and alpine communities than previously believed.

Field staff and volunteers will continue to map **cheatgrass** in backcountry locations. Isolated populations that threaten Yosemite's wilderness areas will be hand-pulled. In 2014, a remote infestation of cheatgrass was found at Rodgers Lake. At about 20 miles from the nearest road, this is the most remote population of any invasive plant in Yosemite. Isolated patches of cheatgrass in the wilderness may need to be treated with glyphosate.

APPENDIX A: 2018 INVASIVE PLANT EARLY DETECTION WATCH LIST

This list is populated with species recognized by the state of California to be highly invasive weeds that are known to occur within 50 miles of Yosemite National Park. This list serves as a tool for managers to increase awareness of present and future threats; it is regularly checked, updated, and disseminated to IPP staff who remain vigilant to rapidly respond to any newly discovered occurrences. Distribution data are derived from CalFlora, the California Invasive Plant Council (Cal-IPC), and the California Consortium of Herbaria (CCH) records.

Species	Common Name	Cal-IPC Rating	CDFA Rating	Present in Park
<i>Acroptilon repens</i>	Russian knapweed	Moderate	B	No
<i>Aegilops cylindrica</i>	Jointed goatgrass		B	Yes
<i>Aegilops triuncialis</i>	Barb goatgrass	High	B	Yes
<i>Anthoxanthum odoratum</i>	Sweet vernal grass	Moderate		No
<i>Arundo donax</i>	Giant reed	High	none	Yes
<i>Brachypodium distachyon</i>	False brome	Moderate		No
<i>Brassica tournefortii</i>	Sahara mustard	High	none	No
<i>Centaurea diffusa</i>	Diffuse knapweed	Moderate	A	No
<i>Centaurea iberica</i>	Iberian star-thistle		A	No
<i>Centaurea stoebe</i>	Spotted knapweed	High	A	Yes
<i>Chondrilla juncea</i>	Rush skeletonweed	Moderate	A	Yes
<i>Cirsium arvense</i>	Canada thistle	Moderate	B	No
<i>Conium maculatum</i>	Poison hemlock	Moderate	none	Yes
<i>Cortaderia</i> spp.	Pampas grass	High		No
<i>Cynoglossum officinale</i>	Hound's tongue	Moderate	none	No
<i>Cytisus</i> spp.	Broom	Moderate-High	C	Yes
<i>Dittrichia graveolens</i>	Stink wort	Moderate	none	No
<i>Elymus caput-medusae</i>	Medusahead	High	C	Yes
<i>Euphorbia oblongata</i>	Oblong spurge	Limited	B	No
<i>Euphorbia virgata</i>	Leafy spurge	High- ALERT		No
<i>Genista</i> spp.	Broom	High	C	Yes
<i>Glyceria declinata</i>	Low manna grass	Moderate		No
<i>Isatis tinctoria</i>	Dyer's woad	Moderate	B	No
<i>Lepidium chalepense</i>	Lens-podded hoary cress	Moderate- ALERT		No
<i>Lepidium latifolium</i>	Perennial pepperweed	High	B	No
<i>Linaria dalmatica</i>	Dalmatian toadflax	Moderate	A	No
<i>Linaria vulgaris</i>	Toadflax	Moderate	none	No
<i>Myriophyllum aquaticum</i>	Parrot's feather	High-Alert		No
<i>Myriophyllum spicatum</i>	Water milfoil	High	none	No
<i>Onopordum acanthium</i>	Scottish thistle	High	A	No
<i>Ranunculus repens</i>	Creeping buttercup	Limited	none	Yes
<i>Salsola tragus</i>	Russian thistle	Limited	C	Yes
<i>Sorghum halepense</i>	Johnson grass		C	Yes
<i>Spartium junceum</i>	Spanish lotus	High		No
<i>Stipa miliacea</i> var. <i>miliacea</i>	Smilo grass	Limited	none	No
<i>Tamarix</i> spp.	Tamarisk	High		Yes

CALIFORNIA INVASIVE PLANT COUNCIL (CAL-IPC) RATINGS

Definitions of Cal-IPC weed ratings (California Invasive Plant Council 2006):

Each plant on the list received an overall rating of High, Moderate or Limited based on evaluation using the criteria system. The meaning of these overall ratings is described below. In addition to the overall ratings, specific combinations of section scores that indicate significant potential for invading new ecosystems triggers an **Alert** designation so that land managers may watch for range expansions.

High – These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.

Moderate – These species have substantial and apparent—but generally not severe—ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.

Limited – These species are invasive but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.

CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE (CDFA) NOXIOUS WEED RATINGS

Definitions of CDFA Ratings (Schoenig 2005):

- **"A"** rated weeds are normally limited in distribution throughout the state. Eradication, containment, rejection or other holding action at the state-county level. Quarantine interceptions to be rejected or treated at any point in the state.
- **"B"** rated weeds are more wide spread. Eradication, containment, control or other holding action at the discretion of the commissioner. State endorsed holding action and eradication only when found in a nursery.
- **"C"** rated weeds are generally widespread throughout the state. Action to retard spread outside of nurseries at the discretion of the commissioner. Reject only when found in crop seed for planting or at the discretion of the commissioner.

REFERENCES

- California Invasive Plant Council. 2006. Inventory List of Invasive Non-native Plants that threaten Wildlands in California. California Invasive Plant Council.
- D'Antonio, C. M., E. L. Berlow, and K. L. Haubensak. 2004. Invasive Exotic Plant Species in Sierra Nevada Ecosystems.
- Gerlach, J. D., Jr., P. E. Moore, B. Johnson, D. G. Roy, D. M. Whitmarsh, D. M. Lubin, D. M. Graber, S. Haultain, A. Pfaff, and J. Keeley. 2003. Alien Plant Species Threat Assessment and Management Prioritization for Sequoia-Kings Canyon and Yosemite National Parks. Open File Report 02-170, U.S. Geological Survey, Carson City, Nevada.
- Schoenig, S., editor. 2005. California noxious & invasive weed action plan. California Department of Food and Agriculture & California Invasive Weed Awareness Coalition.