7.0 INVASIVE PLANTS

7.1 OVERVIEW

The species composition of natural communities in the San Diego region has undergone significant changes since the area was first settled. With the early Spanish explorers and European settlers came livestock and a host of plant species from Europe and Asia. Some species tagged along with the livestock (seeds) and others with trees and shrubs brought in for food, fiber, and to reflect the plant communities the new arrivals had left behind. Over time, some of the introduced annual grasses and forbs became well established on the landscape, often intermixed with native perennial grasses and forbs. Even today, with increased globalization, exotic plant and other species continue to be accidentally or intentionally introduced into our native environments.

Nonnative plants that cause economic, environmental, or human harm are known as invasive plants (Pacific Northwest Research Station 2015). The biological monitoring plan for the San Diego MSCP defines invasive species as aggressive or noxious weed species that are growing or spreading rapidly, outcompeting native species, and difficult to control (Ogden Environmental and Energy Services Co. 1997). Invasive species respond to ecosystem modifications at a landscape level, including removal of native species for development, changes in impervious surfaces and hydrological systems, nitrogen deposition, and global climate change, and other disturbances that land managers cannot control (Cal-IPC, Dendra Inc., and CBI 2012). As an alien species with different growth patterns and without many natural consumers, it is often easy for invasives to outcompete native vegetation. Invasive plants can impact native habitats through direct competition for resources such as sunlight, moisture, nutrients, and space. They can also decrease species diversity, degrade water quality, increase soil erosion, and more (U.S. Forest Service Rangeland Management Botany Program, n.d.).

Today, there are large areas where introduced annual grasses and forbs dominate and they have converted other vegetation types, such as coastal sage scrub and native grassland to nonnative grassland. Nonnative grasses and forbs may also be a significant component of other vegetation types including, maritime succulent scrub, oak-woodland, and riparian. While these nonnative grasses and forbs are addressed as a threat/stressor, the MSP Roadmap addresses their management as part of the vegetation community or specific species' occurrences, such as rare plant occurrences, where they occur.

In addition to invasive grasses and forbs, there are invasive broadleaf plants, shrubs, and trees that negatively impact wildlands. Invasive species can have a localized effect on a particular species, or they can create a cascade of effects that impact whole vegetation communities. Land managers and scientists throughout San Diego have conducted many studies that evaluate different aspects of invasive plant life cycles or management options. Results of those studies and others are invaluable in forming treatment recommendations for invasive plants, similar to those outlined in the Invasive Plant Strategic Plan (IPSP). The IPSP organizes many of San Diego's invasive plants by degree of abundance and manageability. The locations of the invasion, the treatment status, the lead organization, and more are described in the plan. The IPSP, plus the MSP invasive plant objectives, lay the foundation for invasive plant management in the MSPA.

7.2 EFFECTS OF INVASIVE PLANTS ON SOUTHERN CALIFORNIA ECOSYSTEMS

Invasive plants can impact the native habitat in a single way or many ways, with often more than 1 nonnative species invading an area. Some of those impacts are summarized below.

7.2.1 Agriculture

Invasive weeds can invade grazing lands, replacing desirable or native forage with unpalatable and toxic plants. Foliage with toxic properties can harm and even kill livestock that have consumed it. Other plants with thistles, thorns, or spikes can directly injure livestock by lodging in their eyes or mouths.

In addition to livestock damages, there are also economic losses from the impacts of invasive plants on crops. For example, purple loosestrife, *Lythrum salicaria*, has the potential to clog irrigation systems and infect rice fields (Benefield 2000). Other invasive weeds may crowd out crops in addition to consuming the water and fertilizer intended for those crops. Losses from crop yield and treating invasive weeds impacting crops cost the U.S. economy an estimated $27 billion annually (Pimentel et al. 2005).

7.2.2 Soil

Similar to certain native species, the leaf litter and root exudates of some invasive species have allelopathic properties that reduce the germination of native plants.

Other alternations to the soil include salt and nitrogen increases. For example, saltcedar (*Tamarix* spp.) increases soil salinity through salt inputs from the glands on its leaves. This increased salinity inhibits the growth and germination of native riparian plant species. In some cases, increased leaf litter from invasives can increase the nitrogen in the soil, creating a disadvantage for native plants that compete better at lower nutrient levels. Early germination, large numbers of plants, and deep roots are all characteristics that allow invasive plants to outcompete native plants for water stored in the soil. One such plant is giant reed, which forms giant monoculture stands that monopolize the moisture in the soil.

7.2.3 Recreation

Recreation, tourism, and ecotourism suffer substantial losses from invasive plants through the reduction of access; reduction of wildlife or native habitat viewing; and the increased nuisance to boating, swimming, and diving (Charles and Dukes 2007). Yellow starthistle (*Centaurea solstitialis*) is an example of a plant that can limit access to recreational areas. Purple loosestrife (*Lythrum salicaria*) is a wetland plant that can clog waterways and wetlands used for boating and other recreational activities (Benefield 2000).

7.2.4 Shade/Light

Plants that grow vertically along streambanks (e.g., giant reed) provide little to no shade to the surrounding riparian and in-stream habitat in contrast to the native riparian vegetation. This shade reduction increases exposure and water temperature, while reducing the habitat quality for aquatic wildlife such as arroyo toad, California red-legged frog, southwestern pond turtle, steelhead trout, and others (Franklin 1996; cited in Dudley 2000). In addition to removing shade, many invasives can carpet the native landscape, depriving native species of the light needed to germinate, survive, and thrive.

7.2.5 Food Supply

Without adaptation, specialists that rely on a small range of flora or fauna for survival may be harmed by the conversion of their native food source to an invasive one. In a review of 87 articles evaluating the response of arthropods to nonnative invasives, Litt et al. (2014) found that arthropod abundance decreased in 62% of the studies. One invasion that supports these findings is French broom (*Genista monspessulana*), which is responsible for reducing one-third of the arthropod population in Golden Gate National Recreation Area (Langford and Nelson 1992).

When nonnatives grow in monocultures, there may be a reduction of food supply from the limited number of insects that forage on nonnative species. Additionally, foraging and grazing habitat is reduced and degraded when unpalatable, toxic, or harmful invasive plant species replace the native forage species.

7.2.6 Erosion

Invasive plants with shallow root systems can contribute to soil erosion. When invasive species alter the fire regime, increasing fire frequency, this can also contribute to accelerated erosion.

7.2.7 Hydrological Regimes

Saltcedar and giant reed both have high evapotranspiration rates, which can lower water tables, increasing the difficulty of attaining water for native plants (Dudley 2000). Large monocultures of invasive reeds can alter the channel morphology when the monoculture traps and retains large amounts of sediment and constricts flow. This can lead to narrowing of stream channels and more frequent flooding (Graf 1978).

7.2.8 Fire

"*Invasive plants often increase the frequency of fires by providing more continuous fuels that are easier to ignite. After fires, these weedy invaders typically reestablish more rapidly than native plants, suppressing the recovery of the natives and allowing the weeds to expand their range*" (Bell et al. 2009). The dense growth of invasive plants, like giant reed, increases the amount of biomass available as fuel for fires. Nonnative annual grasses increase fire severity by providing continuous fuel for the fire. Unlike native grasses, these grasses complete their lifecycle before summer, leaving large amounts of dried material that can fuel fires throughout the summer and fall fire season (Bell et al. 2009). The intensity of fires caused by giant reed and saltcedar along the riparian zone can eliminate stands of native riparian plants such as cottonwood, sycamore, and willow. For more information on how invasive alter the natural fire regime, as well as how invasives spread after fire events, see Vol. 2B, Sec. 1.0, Altered Fire Regime.

7.2.9 Native Species

"*Invasive species have contributed directly to the decline of 42% of the threatened and endangered species in the United States*" (The Nature Conservancy 2016).

Invasive plant species can displace native species in many ways, often outcompeting native species for light, water, and/or nutrients. Some invasive plants germinate earlier than native species or germinate first following a fire, quickly overtaking the habitat of the native species. If native shrub habitat is converted to nonnative grassland, the habitat value is degraded, depriving species of the plant cover and foraging variety they rely on. When large stands of invasive plant species grow in a once-natural habitat, this can displace the native fauna that depend on native habitat. Nonnatives can lower the species diversity and disrupt native plant diversity. It is also difficult for native seeds to germinate when large patches of invasive plants have displaced the native plant structure and diversity. There are endemic bird species, burrowing animals, and insects that require specific plants or vegetation mosaics for breeding, nesting, and rearing. Removing these natives could be detrimental to those species if they cannot adapt to the invasive plants.

7.3 INVASIVE PLANTS IN THE MSPA

Invasive exotic plants are diverse and widespread. In 2012, there were over 100,000 occurrences of almost 250 invasive plant species in the MSPA (Cal-IPC, Dendra Inc., and CBI 2012). CalWeedMapper, a mapping database maintained by the California Invasive Plant Council (Cal-IPC), has reports of 167 invasive species in San Diego County. There are many types of invasive plants in San Diego County, including annual grasses (*Avena* spp., *Bromus* spp., *Lolium* spp.), perennial grasses (giant reed, pampas grass, crimson fountaingrass), herbaceous broadleaf plants (mustard, fennel, thistles), and woody trees and shrubs (saltcedar, acacias, eucalyptus). According to Cal-IPC, some of the most prevalent invasives with severe ecological impacts are giant reed, *Bromus* spp., and saltcedar. While invasive plant species vary in the degree of effort needed for control or eradication, among the most difficult to eradicate are pampas grass (*Cortaderia selloana*) and giant reed. Giant reed, saltcedar, *Bromus* spp., and pampas grass all occur throughout the MSPA.

Giant reed is the most common invasive plant in riparian areas of southern California (Bell et al. 2009). It is a perennial grass that has invaded areas in central California to Baja California, Mexico (Dudley 2000). It is typically found in riparian, floodplain, or coastal areas below 350 meters, and is most problematic in southern California coastal drainages where it can dominate entire river channels bank to bank (Jackson 1994; Bell 1997; both cited in Dudley 2000). Plants range from 2.5–9 meters tall and can tolerate a range of soil types and a range of fresh to semi-saline water (Dudley 2000). Giant reed spreads vegetatively from rhizomes or plant fragments. Stands of giant reed displace native plant and animal species, with the monoculture of giant reed reducing habitat and food supply by displacing the

native vegetation. The reduction in insect populations is especially important for listed species such as the least Bell's vireo, southwestern willow flycatcher, and yellow-billed cuckoo (Frandsen and Jackson 1994; Dudley and Collins 1995; both cited in Dudley 2000). The vertical growth of giant reed reduces shade along riparian areas, increasing in-stream temperatures and decreasing the habitat suitability for listed species like steelhead trout, arroyo toad, and southwestern pond turtle among others. Giant reed has a shallow root system that may promote bank erosion. It can also alter channel morphology, increasing the risk of flooding during heavy rain events. By creating more than double the normal fuel supply, giant reed increases the potential for fire in urbanized areas.

Brome (*Bromus* spp.) are nonnative annual grasses from Europe that, unlike native grass species, germinate in the winter and complete their life cycle before summer (Bell et al. 2009). These nonnative grasses have displaced much of the native grasses throughout California. Few *Bromus* spp. seeds remain dormant each year, making seeds the main source of brome infestation. Due to this, seed bank reduction is the most important aspect of brome management (Hashem and Borger 2016). As a winter annual, the prevalence of *Bromus* spp. is concerning due to the amount of dead fuel left during the summer and fall fire season.

Saltcedar is common in riparian areas where surface or subsurface water is available through most of the year (Lovich 2000). It thrives on saline soils that are uninhabitable for most native woody and riparian plants. The presence of saltcedar is associated with "dramatic changes in geomorphology, groundwater availability, soil chemistry, fire frequency, plant community composition, and native wildlife diversity" (Lovich 2000). The leaf-litter from saltcedar contributes to the increase in fire frequency. Additionally, saltcedar is able to resprout strongly following a fire.

Pampas grass is a perennial grass growing 2–4 meters tall (DiTomaso 2000). In southern California, pampas grass inhabits the banks of sandy and moist ditches in the coastal region. The plants often have a build-up of dry leaves and flowering stocks that increase fire potential. Additionally, pampas grass outcompetes native vegetation. Few control strategies are available for pampas grass and, as a rapid resprouter, burning is not an effective control method (DiTomaso 2000). Hand-pulling of seedlings is effective, but tools are needed to remove the larger plants with established clumps. Detached plants have the potential to take root if left on moist soil, so it is important to remove the entire crown and top section of the roots (Harradine 1991; cited in DiTomaso 2000). Chemical control can be achieved with a spot treatment of post-emergence application of glyphosate. Fall applications result in better control compared to summer applications (Costello

1986; cited in DiTomaso 2000). To reduce the amount of herbicide used, the top foliage can be removed and only the regrowth is retreated.

7.4 RESULTS OF INVASIVE PLANT STUDIES IN THE MSPA

There are many studies addressing invasive plants in the MSPA. Some of these studies focus primarily on rare plants with discussions on specific invasive species threatening those rare plants, and other studies are directly focused on the management and monitoring of specific invasive plant species. The results and progress of some of these studies are summarized briefly below.

RECON's Otay Tarplant and San Diego Thornmint Restoration and Enhancement Project was intended to restore native grassland and clay lens habitat for Otay tarplant (*Deinandra conjugens*) and San Diego thornmint (*Acanthomintha ilicifolia*) in areas currently dominated by weeds (RECON 2012). A goal of the project was to reduce competition with nonnative weeds by controlling nonnative grasses and perennial weeds such as fennel (*Foeniculum vulgare)* and artichoke thistle (*Cynara cardunculus*). Purple needlegrass was planted in areas dominated by nonnative grasses and other weeds.

A Center for Natural Lands Management herbicide application study examined the thread-leaved brodiaea's tolerance to the grass-specific herbicide, Fusilade®, to assess the potential for herbicide treatment of nonnative grasses that occupy thread-leaved brodiaea habitat (Vinje et al. 2009). Other treatment combinations such as dethatch and dethatch with herbicide application were also examined. Researchers found that Fusilade® did not appear to harm thread-leaved brodiaea and plots with herbicide treatment had increased vegetative and flowering numbers. The plots with dethatch and dethatch/herbicide treatments also saw an increase in thread-leaved brodiaea. However, if using dethatching to restore thread-leaved brodiaea habitat, then native forbs and grasses must be planted to fill the open niche.

A study investigated the tolerance of the San Diego ambrosia to herbicide used to control the invasive weeds negatively affecting it (Kelly et al. n.d.). Impacts from the weeds include competition for limited water, blocking sunlight, impeding wind pollination from taller weeds, and loss of genetic variation. With San Diego ambrosia hidden by tall weeds, it would be risky to spray an herbicide for nonnative grass control, since it would be difficult to avoid spraying San Diego ambrosia. Phase I of this 4-part study tested the tolerance of herbicide for San Diego ambrosia in pots. These plants showed no harmful effects from the Fusilade

II® spraying. Phase II assessed the tolerance of 6 native grassland species that are San Diego ambrosia cohorts. Aside from purple needlegrass (*Nassella pulchra*), all other plants showed moderate to severe damage. Phase III was a test of Fusilade® on San Diego ambrosia in the field at Mission Trails Regional Park. There was no apparent damage to San Diego ambrosia and good control of the nonnative grasslands. Additionally, red-stemmed filaree (*Erodium cicutarium*) appeared to be dying after the application. Phase IV further investigated the response of purple needlegrass to Fusilade®.

The extent and dominance of purple false brome (*Brachypodium distachyon*) in San Diego County has grown in recent years, possibly due to reoccurring fires and climatic conditions (CBI 2014). Purple false brome not only decreases native species diversity, but it may also alter the soil composition, vegetation community structure, and natural fire regime. The high density of purple false brome threatens edaphic endemic plants such as San Diego thorn-mint, San Diego goldenstar, thread-leaved brodiaea, Orcutt's brodiaea, Otay tarplant, variegated dudleya, Dehesa nolina, and Parry's tetracoccus. Native grassland and coastal sage scrub communities are also threatened by the high density of purple false brome on restricted soils. To protect conservation target species from purple false brome invasion, CBI developed a study to, among other things, identify variables that may respond to control treatments and be used to develop restoration strategies. The study also predicted areas currently at risk of invasion and under future climate regimes. One major finding of the study was that a single Fusilade ® application per year provided effective control of purple false brome when done in a uniform and timely manner relative to rainfall. The dethatch-herbicide-seeding combination had the highest number of native species.

The South County Grasslands Project, a collaboration initiated in 2011 between the South County Land Managers, CBI, and The Nature Conservancy, developed landscape-scale conservation visions and restoration plans for native grassland and forbland habitats (Land IQ and CBI 2015). The Quino checkerspot butterfly and the Otay tarplant are specifically targeted in this project. This 4-phase project tested restoration methods for controlling invasive grasses and restoring native grasslands and forblands. Quantitative data were used to assess the effectiveness of site preparation methods in the first growing season post-seeding. This project is in the fourth and final phase, using quantitative data from 3–5 years of monitoring to determine the long-term trajectory and success of the experimental restoration treatments.

A conservation vision created by CBI evaluates the status and threats for the endangered Dehesa nolina, prioritizes management actions by population, and identifies survey and research needs (CBI 2015). Invasive species such as purple false-brome, tocalote (*Centaurea melitensis*), and red brome (*Bromus madritensis*) are listed as threats to Dehesa nolina. Of particular concern is purple false-brome because of the potential for widespread invasion following fire or other large-scale disturbances.

7.5 MANAGEMENT AND MONITORING APPROACH

The overarching goals for addressing invasive plant species in the MSPA are to:

(1) Protect Conserved Lands from new or expanding invasive plant species

(2) Detect new invasive species and new invasions early on and control them before the plants have a chance to establish

(3) Address invasive species using the response appropriate for the level of invasiveness (levels 1 through 5) as defined in the IPSP

The approach for managing invasive plants is divided into 2 parts: general and species-specific. General invasive plant objectives focus on early detection and eradication as well as the IPSP recommendations across the MSPA. Species-specific objectives have been developed for those MSP species identified as at highest risk from loss due to invasive plants, and for which specialized objectives (i.e., chemical and manual removal, restoring habitat) are required to ensure their persistence in the MSPA.

7.5.1 General Approach Objectives

Below is a summary of the management and monitoring objectives for the threat of invasive plants. For the most up-to-date goals, objectives, and actions, go to the MSP Portal Invasive Plant summary page: http://portal.sdmmp.com/view_threat.php?threatid=TID_20161207_1453.

Continue to Implement the Invasive Plant Strategic Plan

In 2012, collaboration between CBI, Dendra, Inc., and Cal-IPC created a regional strategic plan for the management and monitoring of invasive plant species. In the development of the IPSP, 55 nonnative plant species were assessed and scored using a regional plant assessment process that evaluates abiotic and biotic impacts,

invasiveness, and distribution. Twenty-nine of those species were addressed in the plan for near-term management and monitoring. Those 29 invasive plant species are considered more recent species arrivals and are divided into 5 management levels (Table V2B.7-1) (Cal-IPC, Dendra Inc., and CBI 2012). Some prevalent invasive plants were not ranked in the IPSP because they have become widely established in the landscape (e.g., bromes, mustard, clover, etc.) and are the primary species in the nonnative grassland vegetation community. Use the following online map to view the invasive plant detections: http://arcg.is/2hYs6xq.

The approach for managing invasive plant species is to follow the recommendations provided in the IPSP. Early Detection and Rapid Response programs are the best way to manage Level 1 and Level 2 invasive species, and eradication is the goal for those species within the MSPA. The goal for Level 3 species is eradication within geographical areas (e.g., watershed, MU etc.) where management will significantly benefit MSP species. The goal for Level 4 and Level 5 species is eradication in the areas where they adversely affect narrow endemic plant species, primarily Category SL, SO, SS species. Future updates of the MSP Roadmap will include an analysis and maps showing the locations where invasive plants are impacting MSP species. Contact the SDMMP for a map of current locations.

The 5 management levels for invasive plants described in the IPSP are:

- **Level 1:** considered eradicated from the MSPA but need ongoing surveillance to detect any reinvasions and trigger a rapid response to prevent them from becoming reestablished
- **Level 2:** very limited in distribution and eradication is possible with a regionally coordinated eradication program
- **Level 3:** may be abundant in localized areas, but can likely be eradicated within focal areas (an MU, watershed, etc.)
- **Level 4:** abundant and widespread
- **Level 5:** very widespread and control is typically of short-term benefit

In December, 2014, the County of San Diego created the Invasive Plant Species Annual Work Plan to focus on the control of Early Detection and Rapid Response species. This work plan included new Level 2 invasive plant species that were not covered in the IPSP 2012. Those 8 new species are:

Table V2B.7-1. Invasive plants by Management Level as listed in the Invasive Plant Strategic Plan (Cal-IPC et al. 2012).

Scientific Name	Common Name	Mgt Level	Priority	Recommended Actions
Cytisus scoparius	Scotch broom	1	Medium	Surveillance
Euphorbia terracina	Carnation spurge	1	Very High	Surveillance
Aegilops triuncialis	Barbed goat grass	2	High	Monitor
Ageratina adenophora	Eupatory	2	High	Fund management
Carrichtera annua	Ward's weed	2	High	Monitor
Centaurea calcitrapa	Purple star thistle	2	Low	Coordinate
Centaurea solstitialis	Yellow star thistle	2	High	Fund management
Centaurea stoebe ssp. *Micranthus*	Spotted knapweed	2	Medium	Fund management
Elymus caput-medusae	Medusahead	2	Very High	Coordinate; fund management
Genista monspessulana	French broom	2	Very High	Fund management
Hypericum canariense	Canary Island St. John's wort	2	High	Fund management
Iris pseudacorus	Yellow flag iris	2	High	Fund management
Lythrum salicaria	Purple loosestrife	2	Very High	Fund management
Retama monosperma	Bridal broom	2	Very High	Fund management
Arundo donax	Giant reed	3	Very High	Fund management
Cortaderia selloana and jubata	Pampas grass (and jubata)	3	High	Fund management
Cynara cardunculus	Artichoke thistle	3	Very High	Coordinate; fund trial

Scientific Name	Common Name	Mgt Level	Priority	Recommended Actions
Ehrharta calycina	Perennial veldt grass	3	Medium	Additional data
Ehrharta longiflora	Long-flowered veldt grass	3	Medium	Additional data
Emex spinose	Devil's thorn	3	Medium	Coordinate; fund trial
Lepidium latifolium	Perennial pepperweed	3	Very High	Fund management; additional data
Oncosiphon piluliferum	Globe chamomile	3	Medium	Additional data
Spartium junceum	Spanish broom	3	Medium	Coordinate; fund management
Agrostis avenacea	Pacific bent grass	4	Very High	Fund management
Brachypodium distachyon	Purple false brome	4	Very High	Fund management
Dittrichia graveolens	Stinkwort	4	High	Additional data
Foeniculum vulgare	Fennel	4	Very High	Fund management
Silybum marianum	Milk thistle	4	High	Additional data
Glebionis coronaria	Crown daisy	5	Medium	Additional data

Enchylaena tomentosa (ruby saltbush)
Limonium duriusculum (European sea lavender)
Limonium ramosissimum (Algerian sea lavender)
Euphorbia virgate (leafy spurge)
Heliotropium supinum (dwarf heliotrope)
Pentameris airoides (annual pentaschistis)
Senecio quadrdentatus (cotton burnweed)
Sesbania punicea (rattlebox)

The County proposed active control work on 3 of those 8 species (*Enchylaena tomentosa, Limonium duriusculum, and Limonium ramosissimum*), with tracking and monitoring of the other 5 species to ensure that treatment work is occurring.

Update the San Diego County Invasive Plant Species Annual Work Plan

To ensure the appropriate species are identified and targeted for management, it is imperative to regularly update the San Diego County Invasive Plant Species Annual Work Plan. The SDMMP will support and work with the County of San Diego Department of Agriculture, Weights, and Measures to update the annual work plan and include those updates in the focal species table in the MSP Invasive Plant section. They will add any new early detection and rapid response (EDRR) species to the watchlist.

Pursue outside funding for Level 3 invasive plants species

Total eradication is unlikely for Level 3 species, but eradication within focal areas is possible. However, due to the abundance of Level 3 species, EMP funding is unlikely, so funding will likely need to come from outside the region. The SDMMP will pursue other funding and grant options, possibly for wetlands and other habitat types.

Create a Biosecurity Plan

Prevention is the first line of defense in invasive species management. Biosecurity measures are the best way to strengthen and promote prevention efforts. In an ecological context, biosecurity refers to preventative measures intended to reduce the risk of nonnative and invasive species (plant, mammal, invertebrate, etc.) introduction and spread. Biosecurity often includes BMPs for preventing the spread of invasive plant material. Implementing BMPs helps reduce future maintenance and costs, herbicide use, and fire hazards, while also protecting native habitat,

plant populations, and listed species. Cal-IPC's *Preventing the Spread of Invasive Plants: Best Management Practices for Land Managers* (2012) outlines specific prevention BMPs for land managers working with potentially or known invasive material.

The first prevention principle recommends that land managers take time to conduct a pre-activity assessment of the work areas to determine which activities could spread weeds and which BMPs are applicable (Cal-IPC 2012). Other important BMP areas are:

- *Project material BMPs*: using weed-free source for materials
- *Travel BMPs*: plan travel to reduce invasive spread, integrate cleaning activities into travel
- *Tool, equipment, and vehicle cleaning BMPs*: designated cleaning areas, inspections before entering and leaving the site, etc.
- *Clothing, boots, and gear cleaning BMPs*: wear gear that does not retain soil and plant material, designate cleaning areas, clean clothing, boots, and gear before leaving site
- *Waste disposal BMPs*: ensure invasive material is rendered nonviable while still on-site, designate disposal areas for invasive plants, contain invasive material while in transport to disposal site
- *Soil disturbance BMPs*: minimize soil disturbance, implement erosion control, etc.
- *Vegetation management BMPs*: schedule to maximize control efforts and minimize invasive spread, retain native existing vegetation, etc.
- *Revegetation and landscaping BMPs*: revegetate to optimize resistance to invasive plant establishment, use local materials, revegetate or mulch disturbed soils to decrease invasive establishment
- *Fire and fuel management BMPs*: consider wildfire implication when setting priorities for invasive plant control, reduce disturbance when implementing fuel management, revegetate burned areas to reduce invasive spread, etc.

Recommendations for creating a pre-activity assessment and implementing the other BMP categories are detailed in the plan.

Create an Early Detection/Rapid Response Database and Reporting Tool

"*Early detection and rapid response (EDRR) is a management approach that capitalizes on our ability to most effectively eradicate invasive plant populations when they are smll*" (Cal-IPC 2016). Addressing a new invasive plant population while it is small deprives it of a chance to spread or establish a large seed bank. Early detection of invasive species is imperative for avoiding costly long-term control efforts. EDRR involves well-informed surveillance and immediate reporting, followed by eradication measures.

A regional invasive reporting and tracking website would be beneficial for reporting new invasions, as well as tracking management efforts. The website could serve as a regional occurrence database and could be available for public reporting. The database would include a regional watchlist and invasive plant alerts similar to the one operated by Cal-IPC. Plants found in nearby regions with similar habitat should be included on the watchlist. For the watchlist to be most effective, land managers should be diligent in monitoring their properties and be aware of plants on the watchlist. Important information to incorporate in the database includes all suspected and confirmed invasive occurrences, whether or not and how the occurrence is being addressed, and sites where the species has been eradicated. Land managers could periodically review the website to assess what invasive plants are on or near their lands, determine what plants may be an impending problem, and develop an appropriate management strategy.

For information on current EDRR plants in San Diego County, visit the San Diego Weed Management website: http://www.sandiegocounty.gov/content/sdc/awm/ipm_sdwma/InWeedWatch.html?cq_ck=1462552877418.

Support the Removal of Level 4 and Level 5 Species Threatening MSP Species

It is important to remove Level 4 and Level 5 invasive species where they occur and threaten MSP species. The SDMMP will support land managers conducting the removal of these invasive species.

7.5.2. Species-Specific Approach Objectives

The impacts of invasive plant species on rare and endemic species can vary widely. While some invasive plants have a drastic impact on whole plant communities, there are those invasive plants that have a disproportionate effect on certain native species. Species for which invasive plant goals and objectives have been identified as part of their management and monitoring approach are identified in Table V2B.7-2. Use the MSP Portal for the most updated list of species with Invasive Plants objectives.

Table V2B.7-2. MSP plant and animal species with specific invasive plant management and monitoring objectives.

	Scientific Name	Common Name	Management Category	Summary Page Link
Plants				
	Acanthomintha ilicifolia	San Diego thorn-mint	SO	https://portal.sdmmp.com/view_species.php?taxaid=32426
	Acmispon prostratus	Nuttall's acmispon	SO	https://portal.sdmmp.com/view_species.php?taxaid=820047
	Agave shawii var shawii	Shaw's agave	SL	https://portal.sdmmp.com/view_species.php?taxaid=810342
	Ambrosia pumila	San Diego ambrosia	SO	https://portal.sdmmp.com/view_species.php?taxaid=36517
	Aphanisma blitoides	Aphanisma	SL	https://portal.sdmmp.com/view_species.php?taxaid=20679
	Atriplex coulteri	Coulter's saltbush	VF	https://portal.sdmmp.com/view_species.php?taxaid=20523
	Atriplex parishii	Parish brittlescale	VF	https://portal.sdmmp.com/view_species.php?taxaid=20554
	Baccharis vanessae	Encinitas baccharis	SO	https://portal.sdmmp.com/view_species.php?taxaid=183764
	Bloomeria clevelandii	San Diego goldenstar	SS	https://portal.sdmmp.com/view_species.php?taxaid=509575
	Brodiaea filifolia	Thread-leaved brodiaea	SS	https://portal.sdmmp.com/view_species.php?taxaid=42806
	Brodiaea orcuttii	Orcutt's brodiaea	SO	https://portal.sdmmp.com/view_species.php?taxaid=42815
	Brodiaea santarosae	Santa Rosa brodiaea	SS	https://portal.sdmmp.com/view_species.php?taxaid=810190
	Centromadia parryi ssp. australis	Southern tarplant	VF	https://portal.sdmmp.com/view_species.php?taxaid=780715
	Chloropyron maritimum ssp. maritimum	Salt marsh bird's-beak	SL	https://portal.sdmmp.com/view_species.php?taxaid=834234

Scientific Name	Common Name	Management Category	Summary Page Link
Chorizanthe orcuttiana	Orcutt's spineflower	SL	https://portal.sdmmp.com/view_species.php?taxaid=21019
Clinopodium chandleri	San Miguel savory	SL	https://portal.sdmmp.com/view_species.php?taxaid=565077
Cylindropuntia californica var. californica	Snake cholla	VF	https://portal.sdmmp.com/view_species.php?taxaid=913470
Deinandra conjugens	Otay tarplant	SS	https://portal.sdmmp.com/view_species.php?taxaid=780273
Dicranostegia orcuttiana	Orcutt's bird's-beak	SL	https://portal.sdmmp.com/view_species.php?taxaid=834156
Dudleya blochmaniae	Blochman's dudleya	SL	https://portal.sdmmp.com/view_species.php?taxaid=502165
Dudleya brevifolia	Short-leaved dudleya	SL	https://portal.sdmmp.com/view_species.php?taxaid=502166
Dudleya variegata	Variegated dudleya	SS	https://portal.sdmmp.com/view_species.php?taxaid=502182
Dudleya viscida	Sticky dudleya	SS	https://portal.sdmmp.com/view_species.php?taxaid=502185
Ericameria palmeri ssp. palmeri	Palmer's goldenbush	VF	https://portal.sdmmp.com/view_species.php?taxaid=527914
Eryngium aristulatum var. parishii	San Diego button-celery	VF	https://portal.sdmmp.com/view_species.php?taxaid=528066
Erysimum ammophilum	Coast wallflower	SL	https://portal.sdmmp.com/view_species.php?taxaid=22928
Euphorbia misera	Cliff spurge	VF	https://portal.sdmmp.com/view_species.php?taxaid=28104
Ferocactus viridescens	San Diego barrel cactus	VF	https://portal.sdmmp.com/view_species.php?taxaid=19801
Fremontodendron mexicanum	Mexican flannelbush	SL	https://portal.sdmmp.com/view_species.php?taxaid=21581
Hazardia orcuttii	Orcutt's hazardia	SL	https://portal.sdmmp.com/view_species.php?taxaid=502882

Scientific Name	Common Name	Management Category	Summary Page Link
Lepechinia cardiophylla	Heart-leaved pitcher sage	SL	https://portal.sdmmp.com/view_species.php?taxaid=32553
Monardella viminea	Willowy monardella	SL	https://portal.sdmmp.com/view_species.php?taxaid=833060
Navarretia fossalis	Spreading navarretia	VF	https://portal.sdmmp.com/view_species.php?taxaid=31328
Nolina cismontana	Chaparral nolina	SL	https://portal.sdmmp.com/view_species.php?taxaid=507567
Nolina interrata	Dehesa nolina	SO	https://portal.sdmmp.com/view_species.php?taxaid=42992
Orcuttia californica	California orcutt grass	SL	https://portal.sdmmp.com/view_species.php?taxaid=41970
Packera ganderi	Gander's ragwort	SO	https://portal.sdmmp.com/view_species.php?taxaid=565357
Pogogyne abramsii	San Diego mesa mint	VF	https://portal.sdmmp.com/view_species.php?taxaid=32639
Pogogyne nudiuscula	Otay mesa mint	SL	https://portal.sdmmp.com/view_species.php?taxaid=32643
Quercus engelmannii	Engelmann Oak	VF	https://portal.sdmmp.com/view_species.php?taxaid=19329
Rosa minutifolia	Small-leaved rose	SS	https://portal.sdmmp.com/view_species.php?taxaid=504824
Tetracoccus dioicus	Parry's tetracoccus	SS	https://portal.sdmmp.com/view_species.php?taxaid=28420
Invertebrates			
Branchinecta sandiegonensis	San Diego fairy shrimp	SL	https://portal.sdmmp.com/view_species.php?taxaid=624043
Euphydryas editha quino	Quino checkerspot butterfly	SL	https://portal.sdmmp.com/view_species.php?taxaid=779299
Euphyes vestris harbisoni	Harbison's dunn skipper	SL	https://portal.sdmmp.com/view_species.php?taxaid=707282
Lycaena hermes	Hermes copper	SL	https://portal.sdmmp.com/view_species.php?taxaid=777791

	Scientific Name	Common Name	Management Category	Summary Page Link
	Panoquina errans	Wandering skipper	VF	https://portal.sdmmp.com/view_species.php?taxaid=706557
	Streptocephalus wootoni	Riverside fairy shrimp	SL	https://portal.sdmmp.com/view_species.php?taxaid=624020
Amphibians				
	Anaxyrus californicus	Arroyo toad	SO	https://portal.sdmmp.com/view_species.php?taxaid=773514
	Spea hammondii	Western spadefoot toad	VF	https://portal.sdmmp.com/view_species.php?taxaid=206990
Reptiles				
	Emys pallida	Southwestern pond turtle	SL	https://portal.sdmmp.com/view_species.php?taxaid=668677
	Phrynosoma blainvillii	Blainville's horned lizard (Coast horned lizard, San Diego horned lizard)	VF	https://portal.sdmmp.com/view_species.php?taxaid=208819
Birds				
	Aquila chrysaetos canadensis	Golden eagle	SO	https://portal.sdmmp.com/view_species.php?taxaid=175408
	Athene cunicularia hypugaea	Western burrowing owl	SL	https://portal.sdmmp.com/view_species.php?taxaid=687093
	Campylorhynchus brunneicapillus sandiegensis	Coastal cactus wren	SO	https://portal.sdmmp.com/view_species.php?taxaid=917698
	Circus cyaneus	Northern harrier	SO	https://portal.sdmmp.com/view_species.php?taxaid=175430
	Empidonax traillii extimus	Southwestern willow flycatcher	SL	https://portal.sdmmp.com/view_species.php?taxaid=712529

	Scientific Name	Common Name	Management Category	Summary Page Link
	Passerculus sandwichensis beldingi	Belding's savannah sparrow	VF	https://portal.sdmmp.com/view_species.php?taxaid=179325
	Polioptila californica californica	Coastal California gnatcatcher	VF	https://portal.sdmmp.com/view_species.php?taxaid=925072
	Sternula antillarum browni	California least tern	SO	https://portal.sdmmp.com/view_species.php?taxaid=825084
	Vireo bellii pusillus	Least Bell's vireo	SO	https://portal.sdmmp.com/view_species.php?taxaid=179007
Mammals				
	Lepus californicus bennettii	San Diego black-tailed jackrabbit	VF	https://portal.sdmmp.com/view_species.php?taxaid=900973
	Taxidea taxus	American badger	SL	https://portal.sdmmp.com/view_species.php?taxaid=180565
Vegetation Communities				
	Chaparral			https://portal.sdmmp.com/view_species.php?taxaid=SDMMP_vegcom_3
	Coastal Sage Scrub			https://portal.sdmmp.com/view_species.php?taxaid=SDMMP_vegcom_1
	Grassland			https://portal.sdmmp.com/view_species.php?taxaid=SDMMP_vegcom_2
	Oak Woodland			https://portal.sdmmp.com/view_species.php?taxaid=SDMMP_vegcom_10
	Riparian Forest & Scrub			https://portal.sdmmp.com/view_species.php?taxaid=SDMMP_vegcom_7
	Salt Marsh			https://portal.sdmmp.com/view_species.php?taxaid=SDMMP_vegcom_6
	Southern Interior Cypress Forest			https://portal.sdmmp.com/view_species.php?taxaid=SDMMP_vegcom_9
	Vernal Pool/Alkali Playa			https://portal.sdmmp.com/view_species.php?taxaid=SDMMP_vegcom_4

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