4.5.4 Invasive Plant Species

4.5.4.1 Introduction

Following habitat loss, invasive species are the second largest threat to California's biodiversity. Invasive plant species compete for resources and growing space with native species, while the native species often have not evolved to defend themselves against these foreign predators and disease (Barbour, 2007). Invasive species frequently change physical ecosystem processes such as nutrient cycles, hydrology, wildfire regimes, sedimentation and erosion, light availability, and plant community structure (Bossard et al., 2000).

The spread of invasive species has an economic impact also. Extensive areas of rangeland forage have been crowded out by invasive species and because they are low in nutrients or even toxic to livestock, they usually lower the quality and value of land as rangeland. Some invasive plant species generate higher fuel loads than native plants, which can lead to more frequent and catastrophic wildfires increasing firefighting costs, while other invasive species have been shown to lower natural water tables by consuming large quantities of water. Invasive species significantly degrade, and often even eliminate wildlife habitat, putting even more strain on already struggling threatened and endangered native species (CAL-IPC, 2006). The California Invasive Plant Council has estimated that the state of California spends an estimated $82 million on invasive plant work such as controlling and monitoring, and education and over a third of that cost falls on state agencies (CAL-IPC, 2008).

Invasive plant species are most likely found in habitats that have experienced human disturbance. Forest related examples of disturbances are roads, skid trails, firefighting and forest openings. Such disturbance can be associated with VTP vegetation or land management projects. Other examples of disturbed areas where invasive plants are likely to be found are altered water courses, dam sites and agriculture (Bossard et al., 2000).

4.5.4.2 Invasive species effects on wildfire regimes

For many ecosystems, fire regimes are one of their defining characteristics. One of the most extensive influences invasive plants can have on an ecosystem is to alter their fire regimes. As invasive species move into ecosystems, their intrinsic fuel properties, which involve the plant's flammability and ignition potential, and extrinsic fuel properties, which relates to how the plants are arranged on the landscape, both can directly influence fuel loads, fire frequency, intensity and seasonality, and burn continuity. These changes in fire regimes can alter a plant community and even transform entire ecosystems, allowing the invasive species to take over the entire community and also lead to new opportunities for more invasive species to colonize or expand their habitat (Brooks, 2004).

Annual nonnative Eurasian grasses now dominate 98 percent of California grasslands (Barbour, 2007) Nonnative *Bromus spp.*, like cheatgrass, rip gut, and red brome frequently converts native coastal and desert shrubland communities into annual grasslands (Brooks, 2004). The finely textured grasses produce fuels that dry quickly under low soil and low atmospheric humidity conditions and increase the horizontal fuel continuity and fuel bed bulk density which promotes ignitions and fires earlier in the spring and later in the fall than normal fire regimes, often increasing the fire season and changing the ecosystem's historical infrequent fire interval of 60 to 100 years to a rapid 3 to 5 year interval (Barbour, 2007). The invasive grasses are able to exploit these changes in the fire regime by more quickly establishing than the native species in the post fire disturbed areas, and eventually the original components of the plant community have been changed, and in turn alters the entire ecosystem. Once the fire frequency of native shrub landscapes has gone through these type conversion transformations, they may never recover because of changed factors such as soil nutrients and high densities of the invaders seed banks (Brooks, 2004). These new communities burn more rapidly and frequently affecting animals that are dependent on this landscape for forage and cover, such as the sage grouse, black-tailed jack rabbit and Paiute ground squirrel, which in turn affects predators that depends on these species for food, such as golden eagles and prairie falcons. Fast moving fires are lethal to native reptiles, such as snakes and desert tortoises which are killed in these circumstances (Brooks, 2004).

There are fewer invasive species found in California's montane conifer forests than shrub and grasslands, however these ecosystems are also experiencing negative changes from invasive plants, largely due to unintended side effects from past and current management practices. Practices such as logging, livestock grazing and fire suppression have allowed for unusually high woody fuel accumulation and has changed forest systems from surface fire to more intensive crown fires, altering forest fire regimes. If a forest in these altered conditions experiences a wild fire, large crown gaps are created and adult trees and cones are diminished or destroyed, so new tree generation can be slow because normal seed dispersal mechanisms are not functioning. This allows for invasive species to establish. Post fire management can also promote invasive species in conifer forests. The common practice of using herbicides to suppress shrubs in order to reduce competition with new seedlings actually interferes with the natural seral stages of nitrogen fixing shrub establishment, which normally prepares the soil for seedling growth. With the absence of shrubs, invasive annual grasses have a better chance of establishing, which diminishes habitat and food sources for small mammals and eventually alters the fuel structure, fire frequency, and thus entire fire regime (Keeley et al., 2011).

4.5.4.3 Invasive Species Inventory

The leading organization that maintains the most comprehensive inventory of non-native plants in California is the California Invasive Plant Council (CAL-IPC). According to CAL-IPC, approximately 1,800 non-native plants grow in the wild in the state, but approximately 200 are currently being inventoried due to their level of impact on natural ecosystems (CAL-IPC, 2006). Of the species being inventoried, 39 are considered High Impact which are defined as having a severe impact on physical processes, plant and animal communities and vegetation structure. Sixty-five species are classified as Moderate Impact and are considered having a substantial, but not severe impact on systems, while 89 are classified as Limited Impact, meaning they are invasive, but their statewide impacts are minor, or there may not be enough information to rate them higher (CAL-IPC, 2006).

According to the CAL-IPC inventory, the Central Western region, Northwestern and Southwestern regions of California have the highest diversity of invasive plants that are known to have a negative environmental impact (Figure 4.5.4.1). The Central Western region has the highest number of species that are considered to have a negative ecological High Impact (Figure 4.5.4.2).

Invasive Plant Species

Out of California's major ecosystem types, forests and rangeland have the highest number of invasive species, with 37% found in grassland/rangeland and 34% found in Forests/ Woodlands/Scrublands. The remaining 29% are found in riparian, wetlands, aquatic and dune habitats (Barbour, 2007).

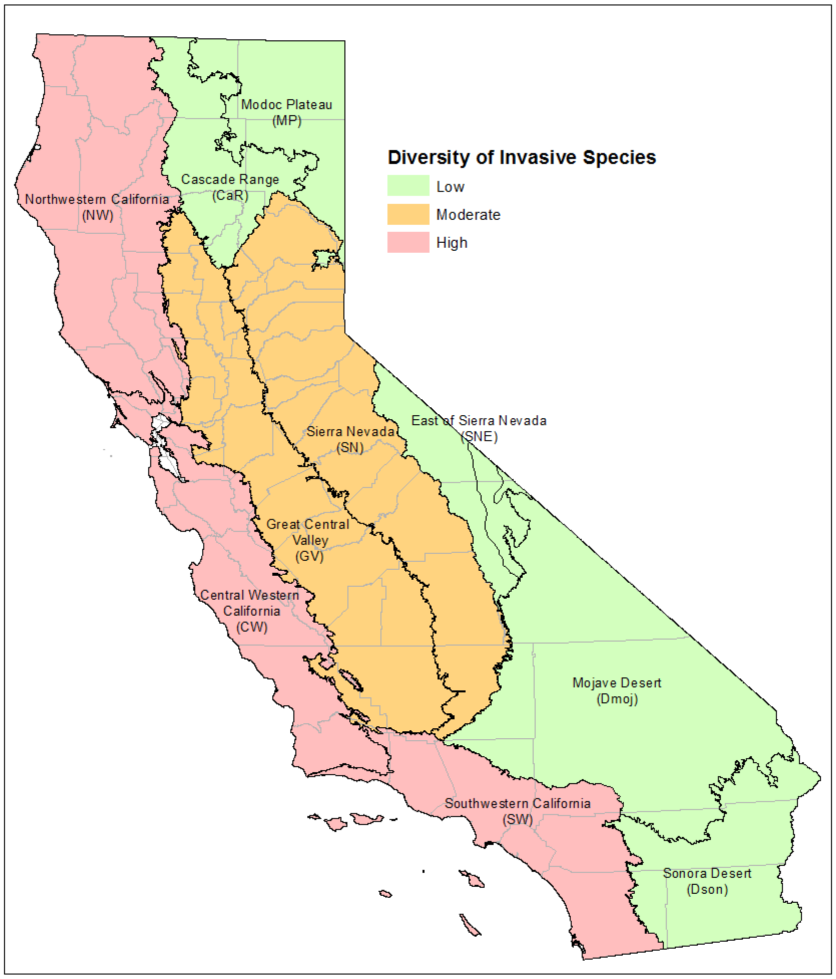

Figure 4.5.4.1 Diversity of Invasive Species
Source: CAL-IPC, 2006. California Invasive Plant Inventory

Invasive Plant Species

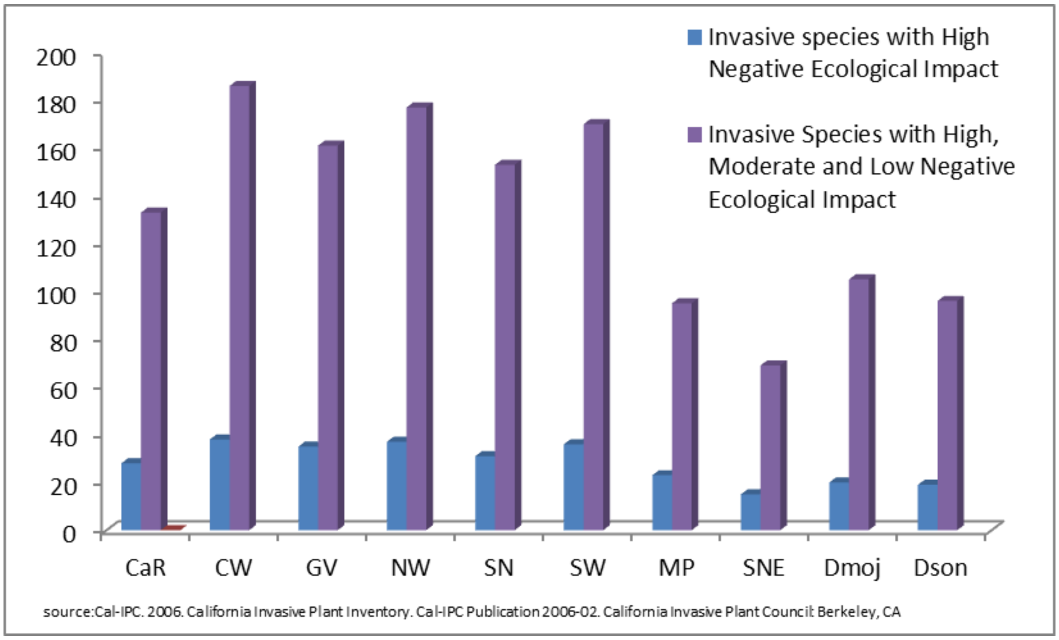

Figure 4.5.4.2 Ecological Impact of Invasive Species

High Impact Species Profiles

Below is a profile of some of the more problematic invasive species in California forest and range wildlands. All of the species profiled below have been categorized by the California Invasive Plant Council in the High Impact level, because of their aggressive ability to displace natives and disrupt natural habitat, and because of their widespread distribution across the state.

Yellow starthistle *(Centaurea solstitialis)*

Yellow starthistle is most commonly found in the Sacramento and northern San Joaquin Valleys, Inner North Coast Ranges, northern Sierra Nevada foothills, Cascade and Klamath Ranges, and the central-western regions of the state (DiTomaso et al., 2000). It is rapidly spreading in mountain regions below 7,500 feet and in the central western region. The California Department of Food and Agriculture (CDFA) has conducted surveys and estimates that the weed covers over 12 million acres in California (CDFA, 2012). Starthistle is very productive because it produces large numbers of seeds and grows quickly, and it tends to spread to disturbed areas, but it is also capable of spreading into pristine regions too (DiTomaso et al., 2000).

Yellow starthistle is considered one of the most problematic rangeland invasives in the state of California. It depletes, and even destroys rangeland forest quality by depleting the forage nutrients and can be poisonous and even lethal to some types of livestock. It can also become a physical barrier and limit access to recreation areas. It degrades private property, range and timberland values. Yellow starthistle is also devastating to natural ecosystems because it displaces native plants and animals and changes geomorphologic systems by lowering moisture levels in annual grasslands, and causing a shift in ecosystems (DiTomaso et al., 2000).

Invasive Plant Species

Tamarisk Species (*Tamarix spp.)*

Tamarisk species, is readily found throughout the Mojave and Colorado Deserts, Owens Valley, Inyo County, Central and South coasts, San Joaquin Valley, San Francisco Bay Area, Sacramento Valley, particularly Yolo and Solano Counties. It is most often located where there is year round surface or subsurface water available, such as stream banks, lakes and pond edges, springs, canals, ditches and some washes. It tends to establish in disturbed sites, including burned areas (Lovich, 2000).

Tamarisk is well known to cause geomorphologic changes because it has a high evapotranspiration rate and it uses more water than native species so it limits ground water availability by lowering water tables which reduces or eliminates surface water for native plants and animals, which can change an entire plant community composition. It can trap sediment which usually alters the shape, carrying capacity, and flooding cycles of the washes. It also tends to increase fire frequency by creating fuel loads from accumulated deciduous leaf litter. It tends to change soil chemistry by increasing soil salinity and overcomes native riparian plant communities (Lovich, 2000). Native bird, small mammal and invertebrate diversity usually decrease where native woodland communities have been replaced by tamarisk (Stien et al., 1996).

Scotch broom English broom, common broom *(Cytisus scoparius)*

Scotch broom is found along most of the California coast from Monterey north to the Oregon border, northern California's interior mountain's lower slopes in El Dorado, Nevada, and Placer Counties. It also exists in Los Angeles and San Bernardino Counties. It's usually found in disturbed areas such as road cuts, and forest clearcuts, but also colonized along river banks, grassland, shrubland, and forest borders below 4,000 feet (Bossard, 2000).

Scotch broom reproduces rapidly and spreads easily. A medium-sized shrub can produce over 12,000 seeds a year, seedbanks can remain dormant for up to 80 years, and they can be readily dispersed by rain water, and the plants can resprout from the root after cutting, fire and even freezing (Bossard, 2000).

Scotch broom frequently out-competes native plants, turning plant communities into monotonous stands. Scotch broom can be detrimental to forest revegetation projects because it shades out tree seedlings. It can also aid in fire frequency and intensity, because it burns well and aids in carrying fire to the tree canopy. The seeds can be toxic to ungulates and the foliage can be dangerous for horse health. It's immense and long living seedbank makes it a very difficult species to control (Bossard, 2000).

Giant reed (*Arundo donax)* and pampasgrass (*Cortaderia selloana*)

Giant reed and pampas grass are found in the Central Valley, Coast Range, North Coast region, the San Francisco Bay Area Southern California and Mojave Desert. Both of these invasive species are tall perennial grass (family *Poaceae*) that typically forms dense stands on disturbed sites, dunes, riparian areas, and wetlands. Some stands span entire river channels. Although they are often associated with disturbed sites, they can also colonize with native riparian stands such as cottonwood and willow (Dudley, 2000).

Both grasses are threatening California's riparian ecosystems by outcompeting native species and even altering hydrological regimes. Giant reed alters riparian communities by shading out in-stream habitat which leads to water temperatures increases. As native plant communities are altered, habitat and food supplies become scarce for native birds, fish and amphibians. These ecosystem changes alter habitat and food supplies become scarce for wildlife. These changes particularly affect insect populations, but also special status species such as least Bell's vireo, southwestern willow flycatcher, and yellow-billed cuckoo, arroyo toad, red-legged frog, western pond turtle, Santa Ana sucker, arroyo chub, unarmored three-spined stickleback, tidewater goby, and southern steelhead trout (Barbour, 2007; Dudley, 2000). The presence of pampas grass in forests can be a problem because it tends to compete with seedlings and impede their establishment and growth. Heavy infestations can even block access to plantations and increase fire hazard (DiTomaso, 2000).

Both species can easily become a public nuisance after flood events because uprooted plants often need to be cleaned up, or they create hazards by getting trapped behind bridges and other structures. They often increase flood control issues by increasing bank erosion and undercutting banks. They often decrease the aesthetic and recreational value of many natural areas (DiTomaso, 2000; Dudley, 2000). Both of these invasive species build up dry leaves and flowering stocks that increases fire hazard and increases the fuel frequency of habitats that historically do not burn on a regular basis and are not adapted to fire (Barbour, 2007; DiTomaso, 2000).

4.5.4.4 Controlling Invasive Species

The most cost effective and efficient method of control is prevention. There are a number of ways to prevent new infestations and limiting the spread of species to new sites. The USDA restricts the movement of many invasive plants, and the California Invasive Plants Council has published a very thorough and highly recommended technical guide for land managers to incorporate into their practices called "Preventing the Spread of Invasive Plants: Best Management Practices for Land Managers." (CAL –IPC, 2012).

If invasive plants are already established and are causing ecological and economic harm then more aggressive action will be needed. Most restoration in California involves removing or controlling invasive species in order to reestablish a healthy ecosystem that can sustain desired native species, communities and ecosystem processes (Barbour, 2007).

Invasive plant control/eradication and ecosystem restoration needs to be precluded by a management plan that addresses goals and objectives, identifies and prioritizes the targeted species, (for example species with high potential to alter fire regimes should be high priority), available methods for weed control, and long-term monitoring maintenance and control (Bossard et al., 2000). Long-term monitoring and control of preventing the establishment of new invasive species infestation is a critical element to a successful weed management plan because work hours and resources increases exponentially with the size of the infestation (Barbour, 2007).

There are a variety of techniques that can be used to control invasives: manual, mechanical, encourage competition from native plants, grazing, biocontrol, herbicides, prescribed fire, solarization, flooding and other creative methods (Bossard, et al., 2000). Different methods or a combination of methods have their advantages and disadvantages for each given situation. The manager needs to evaluate their unique situation and the control option that best fit that situation.