Fire and Invasive Plants in California Ecosystems*

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In parts of California and adjacent regions with a Mediterranean climate, nonnative invasive plants are largely concentrated in valleys and foothills. Fire has historically been important in many of these ecosystems. However, human-caused disruptions of natural fire regimes have contributed to widespread invasion by nonnative species.

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Throughout the Coast Ranges and the foothills of the Sierra Nevada and Cascades, high-frequency fire has helped to convert shrublands and closed woodlands into annual grasslands dominated by grasses and forbs that originated in the Mediterranean Basin. Returning these landscapes to their former closed-canopy condition is the only way likely to reduce the presence of nonnatives.

Chaparral Conversion

California's chaparral communities are highly fire adapted. For good regeneration, they require stand-replacing fires at intervals of two decades or more. It might seem counterintuitive that fire would make fire-prone chaparral more susceptible to invasion by nonnative species. However, plants evolve in association not with fire per se, but with a particular fire regime. When the natural fire regime is altered, even highly fire-adapted plant communities can become vulnerable to competition from nonnatives.

Herbaceous growth forms, annuals in particular, are more resilient to higher fire frequencies than woody growth forms. Invasives make few inroads where chaparral communities remain intact, because they cannot establish under the closed canopies. However, as fire frequency increases, the canopy thins and more sites become available for colonization by nonnatives. Nonnative plants in turn increase the flammability of surface fuels, thereby promoting more frequent, lower intensity fires. The altered fire regime ultimately decimates native shrubs, converting chaparral to grassland dominated by nonnative annuals. Conversion is accelerated if fire is combined with grazing.

Urban and suburban development in California has promoted the spread of invasives by introducing many more ignitions and thereby altering local fire regimes. Prescribed burning on sites with higher-than-natural fire frequencies can also favor the spread of nonnative invasives.

Grassland Invasion

Valleys and other sites with relatively deep clay soils, formerly dominated by native perennial grasses, have been converted to nonnative annual grasslands through intensive grazing and plowing. Today, grasslands cover about 8.4 million acres (3.4 million ha) in California, about 99 percent of which are dominated by nonnative annual grasses and forbs.

In California, fires normally occur in summer and fall, when both annuals and perennials are dormant. Annual seeds and perennial basal buds typically survive the fires to regenerate the following spring. However, fires in spring destroy seed crops, favoring the perennials, which can resprout from basal buds. Spring burning can therefore shift the balance from annual exotic grasses to native cover, but only on sites where perennial bunchgrasses are present.

Remaining sites with native bunchgrasses are rare in California. On the vast majority of grasslands, burning prescriptions might alter species composition but will not

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suffice to eliminate exotics. Moreover, spring burning might not be appropriate for community restoration because it also inhibits native annual plants.

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Burned knobcone pine plantation invaded by grasses in southern California. Frequent fires in the region's Mediterranean climate can promote the spread of exotic plants, which dominate 99 percent of California's grasslands. Photo: USDA Forest Service.

Pre- and Postfire Treatments

Fuel manipulation can contribute to invasion by exotic plants. For example, fuel breaks can act as invasive highways, carrying exotic species into uninfested wildlands. Normally destroyed by stand-replacing fires, exotic seed banks can survive the lower fire severities in fuel breaks, resulting in source populations poised to invade adjacent burned sites.

Postfire rehabilitation programs often include seeding of exotic species for erosion control. In the past, seeding has contributed to the spread of noxious weeds such as black mustard and short-pod mustard. Postfire seeding continues to spread exotics such as Italian ryegrass and Zorro fescue, which readily colonize some native habitats. In shrubland, postfire seeding of exotic grasses can contribute to the acceleration of the fire return interval, decimating native shrubs.

Management Implications

Prescribed fire and other treatments to protect and restore ecosystems can have unforeseen adverse consequences. Land managers should keep the following in mind:

- Many grasslands are dominated by annuals due to historical changes in fire regime that have degraded native shrublands. On such sites, the only way to reduce exotic species is to restore closed-canopy shrublands. The first step is to reduce the incidence of human-caused fire.
- Prescribed burning can be effective in controlling noxious weeds. However, it is unlikely to diminish dominance by exotic species unless accompanied by revegetation with native species.
- Management activities can promote the invasion of exotic species. For example:
  - if the frequency of prescribed burning exceeds the natural fire frequency, natives are readily displaced by nonnative weeds;
  - postfire seeding can promote the spread of exotic species and alter historical fire regimes; and
  - fuel manipulations such as fuel breaks can create favorable conditions for nonnative weeds, increasing their movement into wildlands and building seed sources capable of invading after fire. Associating fuel breaks with roadways would reduce the risk.

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