

DAMAGING AGENTS  
AND PROTECTION



VII





# Damaging Agents and Oak Ecology: Management Implications<sup>1</sup>

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Oaks, like most trees, have indeterminate life spans. Damaging agents kill oaks in all age classes and thereby limit the longevity of individual oaks. People who manage oak trees or woodlands are concerned with the health and survival of oaks and must therefore deal with the effects of various damaging agents. Before considering any action to reduce or mitigate damage, an oak manager needs to identify the causal agents and factors and must assess their individual and cumulative impacts. This process requires an understanding of the ecological relationships between oaks and damaging agents.

Oaks evolved under the challenge of various abiotic factors. Some of these factors, such as soil moisture and temperature, are not intrinsically harmful but can become damaging when they reach levels beyond an oak's range of tolerance. Not all oak life stages tolerate the same range of environmental conditions: mature oaks may withstand temperature and moisture extremes that would kill seedlings of the same species. Environmental factors that become critically damaging to one or more oak life stages limit the geographic distribution of the species and may also limit each species to certain kinds of sites within its range. When oaks are growing in favorable sites within their native range, natural abiotic factors usually cause little damage except under atypical conditions, such as extended droughts, high winds, or floods.

Oaks have also evolved under the relentless attack of many different biotic agents. Over time, natural selection tends to weed out the most susceptible host genotypes, so an oak population typically exhibits a moderate level of resistance or tolerance to native pests and pathogens. Nonetheless, oaks may be seriously damaged or killed by some native biotic agents. Under natural conditions, insects and vertebrates that consume acorns can adversely affect oak reproduction. Native pathogenic wood-decay fungi are responsible for most natural mortality of mature oaks. Indeed, in combination with environmental factors, damaging biotic agents may act to limit the native ranges of oak species.

In 1769, or about one to two oak generations ago, the first Spanish settlement was established in California. Since that time, California oaks have been subjected to various new damaging agents which were introduced by settlers. Livestock directly damage and kill young oaks by browsing and trampling and cause further indirect damage by compacting soil and removing organic matter from the soil surface. Livestock grazing has also contributed to the replacement of native understory grasses and forbs with competitive, non-native grasses and weedy broadleaf species. These herbaceous species can rapidly deplete soil moisture, increasing water stress in oak seedlings. Grazing-related changes in the herbaceous layer and the elimination of vertebrate predators have influenced rodent populations and may have increased the amount of damage caused by these native agents.

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Humans have also unwittingly introduced into California various insects and pathogens that damage oaks. Non-native pests and pathogens have the potential to cause greater damage to oaks than native pests because there has been no opportunity for adaptive selection to occur. Fortunately, non-native pests and diseases do not appear to have greatly affected California's oak resource to date. State quarantine and inspection programs have prevented the introduction and establishment of especially serious exotic agents such as gypsy moth and oak wilt, at least so far.

In the past 150 years, humans themselves have become the most significant of all the agents that damage oaks in California. Californians have cut countless oaks to obtain wood products and have cleared vast areas of oak woodland for agriculture and urban uses. Human activities also result in much unintentional oak damage and destruction, especially at the urban-woodland interface. Activities related to development and construction can greatly alter the environmental conditions under which oaks have been growing. Many of these activities, such as grading, trenching, paving, and compacting the soil, can damage oak roots directly. These and other activities (e.g., groundwater pumping, diverting watercourses, irrigating) can also change site microclimate and alter soil moisture and aeration levels to the point that oaks become more susceptible to other damaging agents.

Throughout California's oak woodlands, but especially at the urban-woodland interface, humans have drastically altered the ecosystem in which our native oaks have evolved. Native oak species must now resist the combined action of many different natural and human-related damaging agents acting simultaneously or in sequence. Together, these agents can debilitate or kill oaks that might otherwise tolerate natural agents acting alone. As a result, some oaks may no longer be able to survive and reproduce within portions of their historic range.

Oaks cannot evolve fast enough to adapt to the radical ecosystem changes brought about by California's nonindigenous human population. It is up to us to change our activities and management practices in ways that will allow California's oaks and oak woodlands to persist and flourish. We can follow practices that reduce or eliminate impacts related to human activities, but this alone will not make up for elevated levels of stress and damage associated with altered ecosystems. To ensure the long-term sustainability of oak woodlands, it may be necessary to focus on restoring major parts of the ecosystems in which California's oaks evolved. Although resource managers and policy makers often focus on immediate threats to oaks and oak woodlands, such as clearing for urban development, they must also realize that sparing a tree or woodland from immediate destruction will not guarantee its future survival.