A Planner's Guide for *Oak Woodlands*

Second Edition

Edited by
Gregory A. Giusti
Douglas D. McCreary
Richard B. Standiford

University *of* California
Agriculture and Natural Resources
Publication 3491

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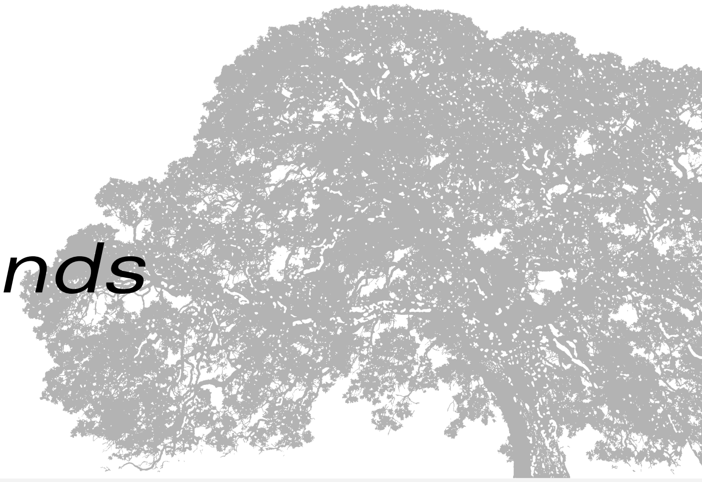

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Preface

Visitors and residents alike identify California's natural diversity by the majestic views of the seashore, the cathedral-like stands of redwoods, the vastness of the deserts, and the expanse and beauty of its native oak woodlands. It is these oak woodlands that have attracted settlers prior to, and since, European colonization. Even today, as urban centers expand, people are attracted to live amongst the oaks. It is this continued encroachment into California's oak woodlands that has given rise to this document.

The words we wrote in the first edition of *A Planner's Guide to Oak Woodlands* in 1992 still ring true today. The encroachment into oak woodlands addressed at the time of the first edition has not stopped, and in some cases it has continued at an alarming rate. As more development occurs in the oak woodlands, planners, consultants, landscape architects, and the concerned public are asking questions that must be answered with some degree of scientific certainty. Oak woodlands are as much a natural ecotype as are the redwoods, the deserts, and the ocean. This expansive forest type covers hundreds of square miles of California and is home to hundreds of resident and migratory species of plants, insects, amphibians, reptiles, fish, birds, and mammals. As concern grows over continued and future listings of species under the Endangered Species Act, professional planners must have access to science-based information from which to make their decisions.

The second edition of *A Planner's Guide for Oak Woodlands* is designed for the professional planner or consultant who has a working knowledge of the planning process. This publication cannot replace experience, wisdom (applied knowledge), or common sense. It can only provide information that can be useful in making a judgment best suited for a particular situation or location.

The first edition of *A Planner's Guide for Oak Woodlands* was the first such document of its kind. This second edition reflects how our knowledge base has increased over the past ten years and includes new examples and experiences. With continued diligence and perseverance specifically targeted at oak woodland resource conservation, California's oaks should survive for future generations. We sincerely hope this publication can help achieve that goal, for us and for our children.

Gregory A. Giusti
Douglas D. McCreary
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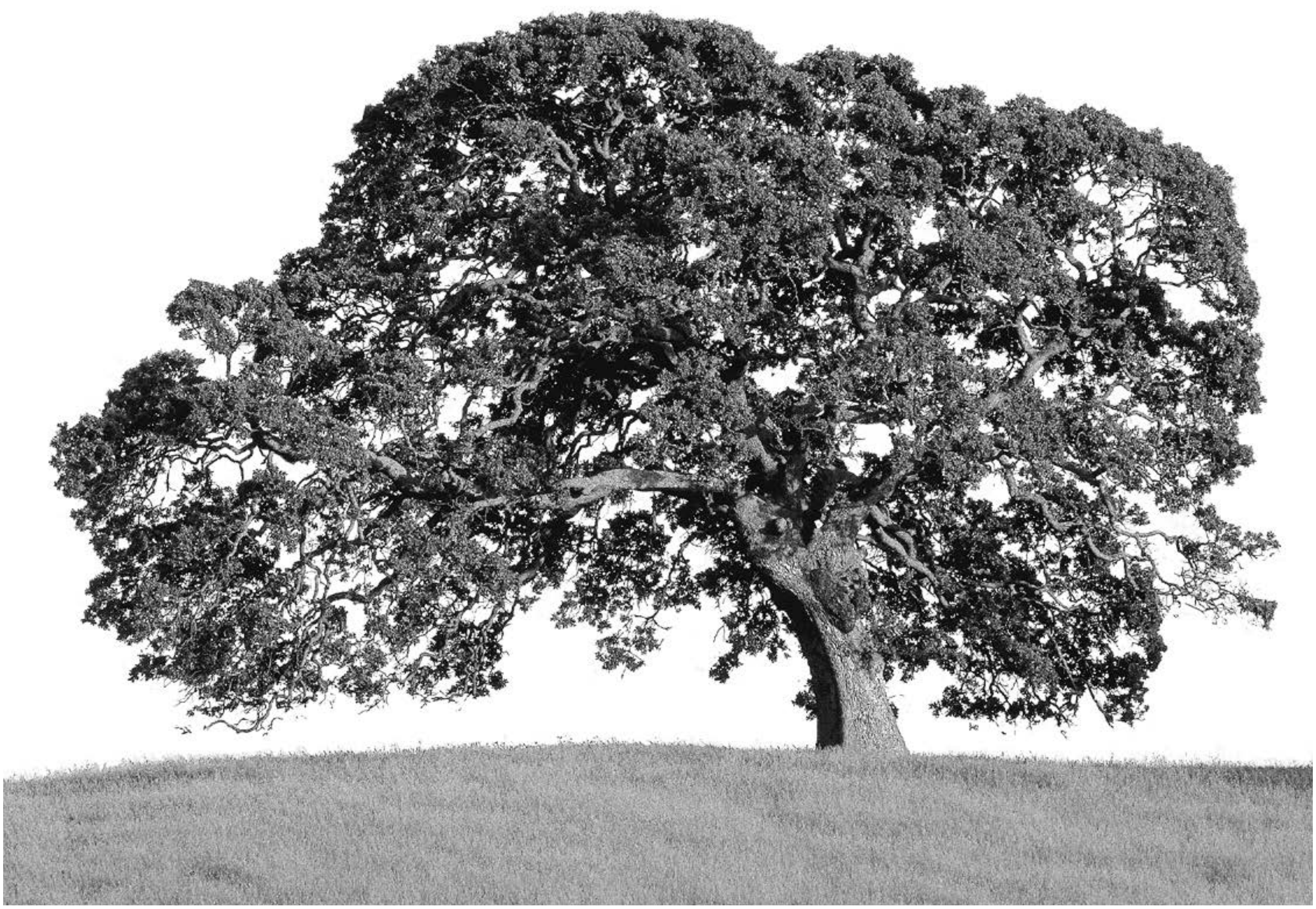
Abbreviations

BMP	Best Management Practices
CCRs	Covenants, Codes, and Restrictions
CDF	California Department of Forestry and Fire Protection
CDFG	California Department of Fish and Game
CE	Conservation Easement
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CWA	Clean Water Act
EIR	Environmental Impact Report
ESA	Endangered Species Act (U.S.)
FPR	Forest Practice Rules
GIS	Geographic Information System
GOPR	Governor's Office of Planning and Research
HCP	Habitat Conservation Plan
IHRMP	Integrated Hardwood Range Management Program
MSCP	Multiple-Species Conservation Plan
MSHCP	Multiple-Species Habitat Conservation Plan
NCCP	Natural Community Conservation Plan
NRCS	Natural Resources Conservation Service
PLM	Private Lands Management Plan
RCD	Resource Conservation District
SWRCB	State Water Resources Control Board (California)
TDR	Transfer Development Rights
TMDL	Total Maximum Daily Load
TPZ	Timberland Production Zone
UC	University of California

A Planner's Guide for Oak Woodlands



Chapter 1

Planning's Role in Oak Woodland Conservation

Gregory A. Giusti, Douglas D. McCreary, and Richard B. Standiford

Since the publication of the first edition of *A Planner's Guide for Oak Woodlands* in 1993, strategies for conserving California's oak woodland resources have taken on many forms. In many cases, these new strategies reflect the evolution of thought from a narrowly defined focus on the preservation of single trees to a more broad-reaching conservation of entire oak woodland systems. Californians' appreciation of the economic and ecological values of oak woodlands has increased dramatically, and this has led to a broader understanding of the role that oaks play in our environment. Consequently, many people who were not formerly involved in discussions or policymaking related to oaks have become engaged in local, regional, and statewide efforts to enhance oak woodland conservation.

The net effect of this broader oak constituency has been greater interaction between people with divergent perspectives in actions and discussions focused on conservation, restoration, and policy development. These interactions have helped people realize that the values associated with oak woodlands are interdisciplinary and complex. The nature of this complexity is evident in this second edition of the *Planner's Guide* as we attempt to address the many conflicting views held by the people of California with regard to the conservation of oaks and their natural landscapes.

California, People, and Oaks

Since the publication of the first edition of the *Planner's Guide*, California has experienced dramatic economic, population, and cultural change. Although change is not new to California, the magnitude of the change that has taken place in such a short period has been unique.

After the end of World War II and continuing well into the 1980s, California's principal economic base was the industrial sector primarily associated with the aerospace industry. Since the collapse of communist rule in Europe and the end of the Cold War, the aerospace industry has been intensively downsized. Once the largest industrial sector in the state, it has now been surpassed by the health-care, entertainment, and communications industries. To illustrate this point, the motion picture industry employs more people in Southern California today than does the aerospace industry. The trend away from industrial manufacturing to high-tech manufacturing and telecommunications has created a more dispersed workforce living in areas that have experienced rapid population growth. Enormous population growth has caused dramatic demographic swings throughout the state. These changes continue to place significant stresses on California's natural resources as people move into areas that have traditionally known few human impacts. Continual increases in population will dramatically shape future land-use decisions and will affect people, their way of life, and the environment in which they live for generations to come (fig. 1.1).

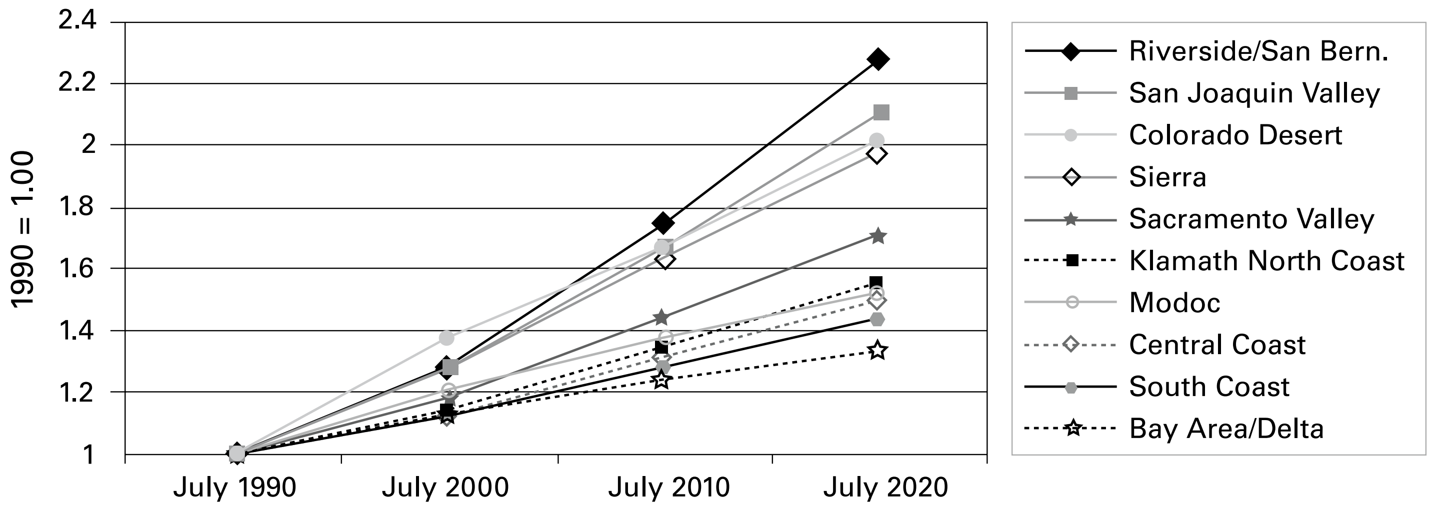


Figure 1.1. Projected population growth for geographic regions of California. *Source:* Fire and Resources Assesment Program 2003.

Historically, California's population surges came from immigration of American residents wanting to take advantage of strong economic conditions in the state. More recently, population growth has been influenced by foreign immigration, as well as by natural increase. As a result, burgeoning urban populations have moved outward to the metropolitan fringe, small towns, and rural areas. Rural communities, in a desire to expand their tax base by actively attracting nonagricultural businesses, have solicited much of this growth. This trend has far-reaching implications for natural resources as traditional agriculture-based economies are transformed into low-density urban centers.

The demographic shifts we see today have reduced the political and economic influence of individuals with a long history in rural areas and a close association with the land. New arrivals often expect urban amenities and landscape features such as streets and roads, golf courses, lawns, landscaping with exotic plants, water developments, cell phone towers, and improvements in other services such as electricity and land-based telephones, while expecting to maintain large tracts of open space. This cultural shift has caused dramatic and sometimes long-lasting impacts on the landscape and its resources.

The increase in the state's population has also been accompanied by an enormous cultural shift. As the state continues to increase in racial and ethnic diversity, citizens will introduce new ideas and values for natural resources that will undoubtedly become part of the debate in the planning process.

These changes in population growth, economy, and culture are producing myriad issues and trends. Collectively, they influence policies on water use and rights, as well as development and growth, and they have encouraged the change from manufacturing- and transportation-based industries to service-based industries capable of establishing job centers away from traditional locations near seaports, railway stations, and industrial areas. The postindustrial age in California has made jobs portable, moving them into rural areas that have historically been based on economies such as farming. This shift has been most notable along the Central Coast and in the interior valleys.

Planning, Policies, and Politics

Demographic shifts have created competing interests that affect the way we address natural resource management in California. Debates often occur between those who want to *conserve* resources, based on consumptive and management philosophies for personal or financial gain, and those who wish to *preserve* resources, an ideology more akin to "let nature take its course," for aesthetic and spiritual enrichment. It is precisely because of these conflicting arguments that we should question whether irrevocable long-term changes to the environment can continue to be addressed though traditional planning mechanisms.

For example, planners who know the history of zoning recognize that zoning laws were developed to preserve the sanctity of family living areas by separating houses from commercial and industrial activities. Zoning has long been viewed as the most appropriate approach to delineate potentially conflicting practices. However, as activities such as agriculture have become more intensive, simple zoning designations may not be sufficient to conserve natural resources and may not prevent conflict between adjoining landowners. This is especially true when farming practices in an area zoned for agriculture change dramatically, altering resources such as water availability or native habitats that affect other public resources held in trust. An example of this would be the transformation of rangelands into vineyards, where the practice of growing an irrigated crop is more intensive than the passive production of livestock. This type of land-use change has led many communities to give greater scrutiny to agricultural practices that had not previously been addressed through zoning overlays.

When a project is proposed that may alter oak woodlands, regardless of the zoning designation, many municipalities have found it necessary to evaluate the potential impacts of the project spatially as a way of minimizing environmental harm to surrounding resources. Depending on the scale and scope of the project, it has sometimes become necessary to undertake a comprehensive planning exercise to assess the environmental significance of the proposed project. This approach can be politically risky, since it usually involves increasing regulations for groups that have traditionally enjoyed special status exempting them from most planning oversight (e.g., agriculture).

Currently, there are no comprehensive planning models that municipalities can use to answer all their oak-related questions. Unfortunately, many land-use decisions are made at the local level and are not always developed through an objective and unbiased process. As a result, local land-use decisions affecting oak woodlands often take on a variety of forms that reflect provincial views and attitudes. They are often the product of diverse interests that have compromised on a solution to complex issues. For this reason, planning can arguably be viewed as one of the most difficult tasks in local government.

This decentralized planning has led local municipalities to develop a number of innovative and imaginative approaches to oak resource conservation, including tree ordinances, grading ordinances, zoning overlays, general plan language, voluntary harvest guidelines, and planning models using a variety of technologies. Though uniquely worded and implemented to meet local expectations, many city and county oak planning schemes lack sufficient monitoring mechanisms necessary to evaluate their effectiveness. Unfortunately, extensive monitoring efforts are often time consuming and expensive. The lack of monitoring subjects local programs to suspicion and uncertainty and adds to the discord between competing interests. Because monitoring is such a rare occurrence in local planning efforts, people have come to rely on other mechanisms to ensure environmental protection, such as up-front conditions intended to minimize overall project impacts on the environment. Additionally, contemporary planning processes involve public notices for many activities that may affect the environment of the site or adjoining parcels. This added level of transparency allows the process to identify and address potential adverse environmental impacts in the absence of postproject monitoring.

With the enactment in 1970 of the California Environmental Quality Act (CEQA), the gap between citizen and developer narrowed dramatically in all aspects of the planning process. Members of the public who have an interest in oak resource management now have a powerful vehicle to ensure that their voice is heard. In the absence of a statewide planning department for oaks, local interest groups can call for CEQA to be used to provide interagency scrutiny and public input for proposed projects that may alter oak woodlands.

Today we take for granted the common practice of subjecting a proposed project to public disclosure requirements that are fundamental to the planning process, such as public hearings, commission meetings, and environmental impact report (EIR) documents. This new reality demonstrates a dramatic shift in public policy since the first edition of this publication was written. Undeniably, the trend allowing for a transparent process that engages the public in natural resource management will continue into the foreseeable future.

Today, more than ever, a planner can influence land-use decisions that will shape the oak landscape and the natural resources for decades to come by applying multiple planning tools and by engaging with the local citizenry.

The Resources

California's natural heritage consists of a wide array of forest and vegetation types found in alpine, Mediterranean, and desert climates. Along with redwoods, Douglas-fir, and bristlecone and ponderosa pine, oak savannas conjure up images of the state's majestic natural beauty. In California, the oak-dominated landscape has been given many names over the years, including oak woodlands, hardwood rangelands, and hardwood forests. In this book we choose to use the term oak woodlands, as it seems to be the most descriptive.

Oak woodlands are defined as lands on which the majority of the trees are of the genus *Quercus*. Some oak woodlands are open and savanna-like, with a few scattered trees dotting the landscape, while others are dense thickets with closed canopies. Each of these types of oak habitats provides a different mix of cover and food for native wildlife, fisheries, and domestic livestock. Other important natural habitat elements in oak woodlands are streams, lakes, vernal pools, and special habitat features supporting both flora and fauna.

Oak woodlands still dominate vast areas of California and are found in a variety of soil and climatic conditions. These forest types have been subjected to many natural disturbances since the Pleistocene ice ages of 10,000 years ago, including climate change, floods, fire, and volcanic activity. However, it has only been in the last 200 to 300 years that human influences have dramatically changed the complexion of oak woodlands, as California's society shifted from a subsistence culture to a more diverse, highly integrated society with intensive mechanized agriculture, mechanized fuel and wood harvesting, and urban and residential development. In some areas, these changes have been so severe that oak woodlands have almost been eliminated from their natural range, further exacerbating conflicts and tensions over dwindling resources.

The Value of Oaks

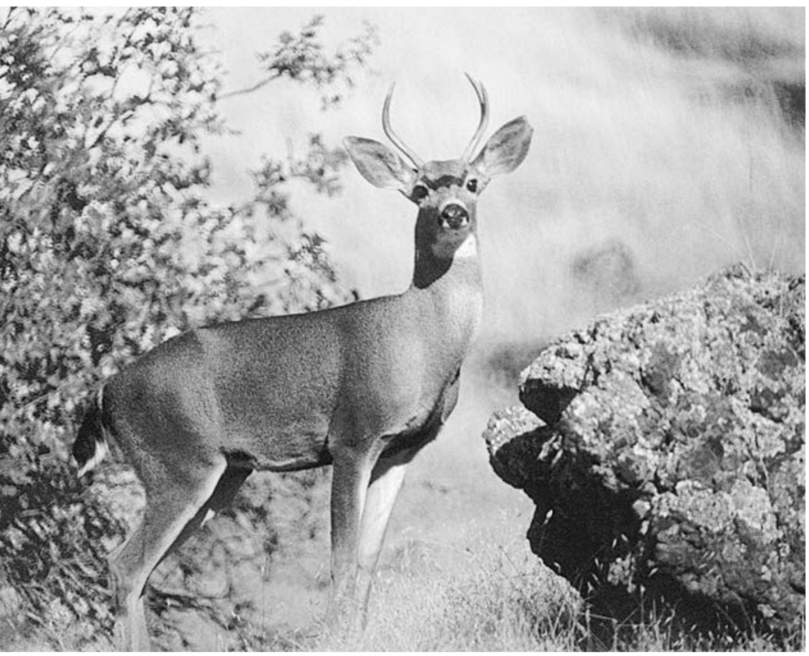
Oaks provide aesthetic, cultural, economic, and environmental value. Much of the debate since the late 1970s regarding oak conservation has focused on the role of the individual tree. For instance, the first edition of this guide stated: "An oak tree can represent many things to many people. It can provide shade over a deck where someone can relax, away from the hustle and bustle of every day life. It can be a therapeutic sight for the tired commuter, who may glance towards a sprawling oak on the side of the road and find visual relief from an exhausting day. It can provide a nest cavity for a western bluebird or violet-green swallow in a backyard, giving a young child a window into the workings of nature." Unquestionably, the value and beauty of an oak tree is in the eye of the beholder.

Today, a city or county wanting to develop a program that truly sustains oak woodlands must focus on the physical and biological components that make up a the entire woodland ecosystem, rather than focusing simply the trees. This comprehensive approach is essential for understanding the relationships between trees and the soil, water, and animals and other plants that live and grow in an oak woodland.

For several years the primary focus of planning discussions has been on maintaining biological diversity through land-use practices aimed at protecting specific habitat elements. Since the publication of the first edition of this *Guide,* however, we have come to understand that maintaining functioning oak woodlands means more than simply addressing the richness or diversity of species found on the site. This fundamental change in the scientific community and among resource practitioners is unfolding as people try to understand how land-use practices and policies impact biological integrity, not simply diversity. The concept of integrity accepts the realization that a number of independent processes go on in an ecological system. For example, we may understand that a certain wildlife species "needs" big trees, open vegetation, or a dense understory, but it is important to know that this same species may require trees large enough to accommodate cavities to raise a brood, open vegetation for their foraging mode of hawking aerial insects, or dense understory vegetation for gleaning insects and protection from predators.

The concept of biological integrity refers to a system's wholeness, including all its necessary elements and processes. This emerging view holds that it is not enough to recognize the potential for oak woodlands to support and maintain multiple floristic and faunal components; it is equally important to understand how land-use decisions impact the ability of woodland components to interact with physical landscape features (water, soil, and air) and how these processes can be sustained over time. For example, an oak woodland development project that proposes to preserve a vernal pool but does not recognize the relationships between the pool and upland vegetation may extirpate a rare plant found in the pool that depends on an insect pollinator whose life cycle depends in turn on the adjoining upland vegetation.

At the core of the debate about biological integrity is assessing cumulative impacts through the planning process. Cumulative impact analysis must understand the relationship between a proposed action or project, taken in context with previous activities, and the potential impacts on ecological processes. In the past, much attention was given to maintaining biological diversity, a scorecard approach to species presence or absence. Today, however, the focus is shifting to determining whether a project may adversely affect multiple interdependent processes that further degrade habitat, impeding a species' existence or recovery.



Threats to Oak Woodlands

Many factors threaten the sustainability of oak species. Natural regeneration of oaks does not appear to be adequate to sustain local populations in areas of California where valley oaks *(Quercus lobata)*, blue oak *(Q. douglasii)*, and Engelmann oak *(Q. engelmannii)* are the predominant species. While the lack of regeneration in these species is sometimes localized and not clearly understood, several factors have been implicated, including changes in the understory plant composition, increases in acorn or seedling predators (ground squirrels, grasshoppers, and deer) and the introduction of exotic seedling- and acorn-eating animals (livestock).

Residential, commercial, and industrial development continues to be the single largest threat to the state's oak woodlands. As human pressures on oak woodland resources accelerate, the structural and compositional complexity of oak woodlands is often simplified, altering ecological relationships and processes that shape the oak forest. Removing trees, diverting water, and building houses, vineyards, roads, shopping centers, parking lots, and other amenities of contemporary life generally fragment the landscape and affect both the diversity and the integrity of forests. Fragmentation can disrupt the ecological processes in these lands, affecting faunal and floral habitats and the animals and plants that depend on them.

The Planner's Guide

This edition of *A Planner's Guide to Oak Woodlands* contains information to help planners and others interested in oak woodland conservation better understand the relationships between oak biology, ecology, and public policy.

As in the first edition, chapter 2 provides a basic review of the biology and ecology of oaks and gives the reader a greater appreciation of the nuances of this unique botanical component of the California landscape. Chapter 3 revisits the relationship between oaks as a vegetation type and the wildlife that depend on oak woodlands for survival. These two chapters provide an overview of the oak as an individual tree and its place in the broader context of landscape ecology. Chapter 4 reflects an evolution in our understanding of oak resource sustainability beyond the single tree or even a single stand to a broader watershed scale. This information can serve as a primer to planners who undoubtedly will be called on in the future to address environmental consequences of successive projects and their potential cumulative impacts. Chapter 4 also explores the emerging influence of watershed groups in the planning process.

Chapter 5 considers how regional planning can address oak conservation. Using many examples from Southern California, the authors discuss planning vehicles that address habitat fragmentation, connectivity, and maintaining biological integrity.

In this second edition, Chapter 6 has been revised to address the expansion of general plans and CEQA in the planning process and their potential for use in oak conservation management. As with any publication that discusses law and public policy, the contents of this chapter should be viewed as a snapshot of the present, since CEQA and the general plans are subject to change and will continue to reshape our thinking about planning and environmental protection.

Chapter 7 provides examples of how contemporary technological advances in planning are being applied in various locations. This chapter allows the reader to visualize the bridge between high-tech applications and on-the-ground conservation.

Chapter 8 revisits one of the planner's fundamental tools, the ordinance, reviewing the utility and application of this essential planning vehicle.

Chapter 9 gives an economic basis for oak woodland conservation to help address the many economic questions that arise regarding the protection of open space and other environmentally important parcels.

The publication is completed by a glossary of technical terms and a bibliography of sources for further reading and research.

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Chapter 2

The Biology of Oak Resources

Douglas D. McCreary and Brice A. McPherson

Species Characteristics

Twenty species of native oaks grow in California. As a group, these oaks have adapted to a wide diversity of habitats, from wet riparian zones to dry rocky hillsides. They are found throughout the state except in the most extreme desert or high mountain environments. It is estimated that oaks grow on nearly 17 million acres (6.9 million ha) (10 million acres of oak woodlands) in California; this represents about one-sixth of the state's total land area. About half of this acreage is found in low-elevation foothills of the Sierra Nevada and Coastal Ranges. Some of the oak species are distributed widely, while others have a much more limited range. For example, canyon live oak *(Quercus chrysolepis)* extends from Oregon to the Mexican border, while the island live oak *(Q. tomentella)* is restricted to five islands off the coast of Southern California and Baja California. In addition, three species—valley oak *(Q. lobata)*, leather oak *(Q. durata)*, and blue oak *(Q. douglasii)*—grow exclusively in California.

Oaks come in all shapes and sizes. Some become towering giants with massive trunks and thick branches; others remain small, shrublike plants throughout their life spans. About half of the species that grow in California are deciduous, losing their leaves in winter. The "live," or evergreen, oaks retain some of their foliage throughout the year. Live oak trees tend to have crooked trunks and forks or multiple stems, while deciduous oaks often have straight lower stems and wide, spreading crowns. Of these deciduous oaks, California black oak *(Q. kelloggii)* usually has the largest section of straight bole, and valley oak has the widest crown spread. Live oaks can form dense thickets with little light penetrating to the ground. As a result, few other plants can grow beneath them. Other species, such as blue oaks, can be widely spaced, with a few single trees dotting hillsides otherwise covered by dense mats of grasses and forbs.

Growth Rates

Oaks grow at varying rates depending on the species, site, and climate. Because of these variables, it is impossible to tell how old a tree is from size alone. Generally, because many oaks tend to grow in dry, or xeric, conditions, they are relatively slow-growing compared to conifers. Recent inventories of blue oaks have shown that it is quite common for trees only 7 inches (18 cm) in diameter to be 100 or more years old. On the other hand, valley oaks, which are usually found in deep, fertile soils with shallow water tables, can grow much more rapidly. It is not a simple matter to determine the age of an oak tree. One technique involves the use of an increment borer to obtain a core so that its annual tree rings can be counted. However, it can be difficult to core oak trees since their wood is so dense and hard. Also, large trees often have hollow centers that make precise age assessments impossible. It is commonly reported that oaks live for 200 to 300 years, yet ring counts on large specimen trees indicate that some trees may live for 500 years when conditions allow.

Survival Strategies

Oaks have evolved different strategies to survive in the varied environments in which they grow. Since many species grow in areas where it is hot and dry, seedlings tend to produce a deep taproot. Even before the leaf shoots emerge, the root may extend downward a foot or more. Once the seedlings are a couple of inches tall, the roots may have penetrated the soil profile by as much as 3 feet (0.9 m), permitting access to soil levels where more moisture is available and allowing the plants to survive under extremely dry conditions.

Another interesting adaptation to low soil moisture conditions is the drought deciduousness of certain species that grow in areas where periodic or seasonal droughts occur. When conditions become so dry that there is insufficient soil moisture, these species drop their leaves to prevent transpiration, thereby conserving moisture. As a result, trees that normally lose their foliage in the late fall can become totally bare in midsummer. While such early leaf loss often causes great alarm in people who think their trees are dying, it usually has little long-term effect, and these trees leaf out and grow normally the following year.

Reproduction

Oaks flower in the early spring, about the same time that new leaves are starting to form. Once the flowers are pollinated and fertilized, acorns start to grow. Some oak species require a single year for the acorns to mature, while others require 2 years. Acorns of both types remain green into the late summer and early autumn, when they turn yellow and/or brown and start to fall to the ground. Acorns mature and drop from August until November.

Acorn crops are notoriously variable from year to year. The factors that control acorn production are not well understood, but it appears that weather at the time of flowering plays an important role, with warm, dry conditions favoring greater acorn production. Acorn crops also appear to be somewhat cyclical, with good or heavy production occurring every 3 to 6 years. Interestingly, a good acorn year for one species may be a poor acorn crop year for another growing in the same area. This is important from a wildlife management standpoint, since retaining trees of several oak species helps ensure adequate acorn supplies for animals that depend on them.

In favorable years, a single large tree may produce thousands of acorns. The vast majority of these will never become seedlings. Many will be damaged by insects or eaten by birds, rodents, livestock, or deer, while others will lie exposed on the soil surface and dry out. A fortunate few will find their way to suitable sites and germinate. But there are still a host of hurdles to overcome before these seedlings become trees.

One of the most serious obstacles is the impact of herbivory from foraging by a variety of animals, including livestock, deer, rodents, and grasshoppers. Repeated browsing can stunt growth or kill seedlings outright. Additionally, herbivory can cause seedlings to grow into plants resembling bushes. It is only when these seedlings become so bushy and wide that the browsing animals no longer can reach the center that the central stem may "escape" and grow taller, eventually growing out of the browse zone to form the main trunk of a new tree.

Insects Affecting Oaks

A multitude of insects are attracted to oaks. Oaks and insects native to California have evolved together and have attained an ecological equilibrium. As a result, while numerous insects can cause conspicuous visual damage to trees and create a nuisance for the landowner, few of these insects actually kill oaks. Even when oaks are totally defoliated by insects, they usually rebound with little long-term damage. Different insects exploit different parts and life stages of oak trees. For example, the larvae of the filbert weevil *(Curculio occidentis)* and the filbert worm *(Melissopus latiferreanus)* often damage acorns. Adults lay eggs either inside or on the surface of the acorns while they are still on the tree. As the larvae grow and develop, they feed on the acorn, eventually emerging through small, visible exit holes. In addition to acorns, insects also attack seedlings, saplings, and mature trees. In some years, high populations of grasshoppers (*Melanoplus* spp.) can totally defoliate small seedlings during summer months, while tent caterpillars (*Malacosoma* spp.), oak worms *(Phryganidia californica),* and leaf rollers (*Archips* spp.) can do the same to mature trees.

Diseases Affecting Oaks

A number of diseases affect native California oaks. The greatest damage to mature trees is usually caused by wood-decay fungi. These organisms often gain entrance to the tree through wounds such as fire scars or places where physical damage has caused branches to fall off or the bark to be removed. As these fungi grow, they progressively decay the wood. This process may take many years or decades. During the initial stages, there may be few obvious external symptoms. Eventually the decay may increase to the extent that essential functions such as water uptake or nutrient transport can become impaired, causing the tree to decline and eventually die. A limited amount of decay is not altogether bad, for cavities created in the decaying wood can provide habitat for many wildlife species. However, decay can cause trees to become structurally weakened, creating a safety hazard for people and property. Several root diseases are common in areas where oaks grow naturally, but most of these do relatively little harm unless the natural environment around the trees is altered. Changes in the environment, particularly activities that increase summer soil moisture, can cause these diseases to become much more destructive.

A recently discovered disease known as sudden oak death (SOD) is caused by a fungus-like water mold named *Phytophthora ramorum.* This disease kills several species of oaks in coastal forests. No one knows how serious or extensive this disease will become, but it could potentially cause significant ecological impacts in areas where it occurs.

Sudden Oak Death and Its Planning Implications

The recent emergence of the disease known as sudden oak death (SOD) promises to complicate planning decisions for oak habitats. Isolated by University of California researchers in 2000, the causal agent of SOD was identified as the fungus-like organism *Phytophthora ramorum*. This pathogen is probably not native to North America, which can be inferred from the low levels of resistance it encounters and its lack of genetic variability. Tree species known to be most at risk are coast live oak *(Quercus agrifolia)*, California black oak *(Q. kelloggii)*, Shreve oak *(Q. parvula* var. *shrevei)*, and tanoak *(Lithocarpus densiflorus)*, which is not a true oak but is a member of the oak-beech family *(Fagaceae)*. Canyon live oak *(Quercus chrysolepis)* appears to be less susceptible than these other oaks. *Phytophthora ramorum* is now considered by many to be one of the largest threats to the health of oak ecosystems in coastal California.

The effects of this disease were first detected in Marin County in 1995. By 2002, infestations were confirmed from Big Sur to southern Oregon, generally within the region of the Coast Ranges. Continued expansion of the geographic range of this epidemic is likely, regardless of any containment efforts. Researchers are seeking to discover environmental variables that may influence infection of oaks in a particular habitat type.

Although the popular name of the disease implies that *P. ramorum* attacks only oaks, the pathogen also colonizes a variety of other plants found in oak habitats, including California bay laurel *(Umbellularia californica)*, rhododendrons (*Rhododendron* spp.), bigleaf maple *(Acer macrophyllum)*, madrone *(Arbutus menziesii)*, manzanita *(Arctostaphylos manzanita)*, evergreen huckleberry *(Vaccinium ovatum)*, poison oak *(Toxicodendron diversiloba)*, California buckeye *(Aesculus californica)*, California coffeeberry *(Rhamnus californica)*, toyon *(Heteromeles arbutifolia)*, California honeysuckle *(Lonicera hispidula)*, Douglas-fir *(Pseudotsuga menziesii* var. *menziesii)*, and coast redwood *(Sequoia sempervirens)*. Most of these non-oak species are not killed by the pathogen, which typically infects the leaves and smaller stems of these plants. Further, all oak species are not equally susceptible. Among the true oaks, the most threatened species all fall within the Erythrobalanus (red oak) group. Canyon live oak is in the Protolanus (golden oak) group. White oaks of the Lepidobalanus lineage, including valley *(Quercus lobata)*, Oregon *(Q. garryana)*, and blue *(Q. douglasii)* oaks do not appear to be affected by *Phytophthora ramorum*. It should be kept in mind that the numbers of oaks and other species identified as hosts are likely to increase as research on this epidemic continues.

The name sudden oak death refers to the rapidity with which the foliage of an infected tree turns brown. This event occurs as the final stage of a disease process that may persist for 5 or more years. Symptoms differ among species. Coast live oak, California black oak, and Shreve oak initially exhibit "bleeding," a viscous red to dark brown seeping through the bark, typically on the main trunk. Bleeding tends to be located within about 6 feet (1.8 m) of the soil surface, although less frequently it appears much higher in a tree. Infection in canyon live oak may be restricted to small stems of understory plants. Tanoaks may initially show bleeding, but more characteristically exhibit scattered leaf death and drooping tips, often followed later by the development of bleeding.

Several secondary organisms frequently occur on trees infected with *P. ramorum*. One particularly dramatic sign of *P. ramorum* infection in the true oaks is the presence of white to reddish brown boring dust produced by small beetles (0.04 to 0.08 inch, or 1 to 2 mm, long) that colonize breeding areas. Beetles may colonize trees within 1 to 2 years after bleeding appears. The charcoal-colored reproductive structures of the fungus *Hypoxylon* may become abundant on the trunk of an infected tree, generally following beetle attacks by at least 6 months.

Infected trees often appear healthy from a distance. Where closer inspection reveals evidence of seeping, *Hypoxylon*, and beetle tunneling, the green foliage of such a tree may belie a structurally weakened condition. The combined effects of beetle tunnels and various wood decay fungi can severely weaken a tree that has been otherwise free of decay.

Although preventive measures may reduce infections on high-value landscape trees, in wildlands minimizing the risk of new infections is the only approach we have available today. Unfortunately, we do not yet understand everything about how this disease spreads and infects stems. There is no evidence that removal of infected trees prevents infection of those nearby, since the sources of inoculum may be ubiquitous in the environment. Plausible mechanisms for the movement of spores include wind, rain splash, animals, and soil in the form of mud on tires and shoes. Commerce in firewood, mulch, soil products, and nursery plants may accelerate movement of infectious material into areas that lack the disease. At present, there are no reasonable prospects for the control of this epidemic in forests and woodlands where *Phytophthora ramorum* has become established. The appearance of the disease in oaks or tanoaks probably lags infection in other hosts plants, it is probable that some nonoak hosts, such as bay laurel and huckleberry, may serve as reservoirs for *P. ramorum*. Proximity to these plants likely increases the probability that oaks will become infected.

Since *P. ramorum* is now part of the California landscape, considerable further mortality is likely of oaks and tanoaks. Consequences of this mortality include increased potential for wildfires, encroachment of invasive weeds such as broom (*Cytisus* spp.), and shifts in species composition toward resistant types. For example, in severely infected regions, oak-dominated forests may give rise to conifer forests. In light of these anticipated changes, protection of oak ecosystems from the effects of development will require thoughtful approaches. These may include management to maximize resistance to disease by maintaining trees in good health and avoiding planting of known hosts.

The extent of natural resistance to *Phytophthora ramorum* is not known. Apparently healthy trees that are surrounded by infected and dead trees may be exhibiting resistance, or may simply have escaped infection.

A federal quarantine currently in place attempts to minimize the spread of sudden oak death to uninfected areas. Planners should work closely with their county agricultural commissioner's office to ensure that proposed projects are consistent with current regulations. Management practices and mitigation measures can be found on the Web site of the California Oak Mortality Task Force at http://www.suddenoakdeath.org. This site also provides maps showing the current confirmed distribution of the disease in the state.

Disturbance around Oaks

Oaks have adapted to withstand the onslaught of insects and diseases they encounter and are generally long-lived. However, the fine balance between oaks and their environment can be easily upset by various human activities. Oaks are especially susceptible to activities and projects that affect soil porosity, compaction, and topography. In the process of building houses, constructing and paving roads, or installing utilities, trees are often damaged, both above and below ground. The wounds to trunks and branches can serve as entry points for wood-decay fungi, and damaged trees may also become more susceptible to insect attacks.

Generally, damage and wounds to the aboveground part of the tree are less detrimental than damage to the root system. Since the majority of roots are located near the soil surface, usually within the top 2 to 3 feet (0.6 to 0.9 m), grading and trenching around trees can cause extensive root injury. Similarly, compaction of the root zone, which often results from operating heavy equipment near trees, can also kill roots by literally suffocating them. Roots need oxygen, and if the soil is compacted, there may not be enough air-filled pores available to keep the roots alive. Backfilling, slope cuts, or increasing the grade around oak roots can have similar injurious effects.

Even if oak trees remain reasonably undamaged during construction activities, they are often exposed to postdevelopment activities that can decrease their chance of survival. Native oaks have evolved in an environment where there is usually little or no summer rainfall. Following development, lawns and other water-dependent vegetation often surround them as part of a landscaping design. The summer irrigation required to keep the landscape plants alive can upset the delicate balance that exists between the oak's root system and fungi that exist in the soil. The area around the trunk is especially sensitive to disturbance. In general, fungal root diseases, including oak root fungus *(Armillaria mellea)* and crown rot *(Phytophthora cinnamomii)*, respond favorably to warm, moist soil conditions. Summer irrigation promotes this condition, thereby supporting fungal growth. As a result, oak roots that were previously able to resist attack can become severely infected. The resultant damage may take several years to become evident, but once symptoms appear on the aboveground portion of the plant, it may be too late to save the tree. Even before visual symptoms are obvious, the tree may pose a safety hazard, since the weakened root systems may no longer be able to support its weight. Such trees can suddenly topple over, resulting in property damage and possibly injury to animals or people.

Protecting Oaks from Damage

To avoid the problems associated with construction activities, protect trees from physical injury and maintain the environment around them in as natural a state as possible. The most critical area for protection is the root zone, inside the drip line. The drip line is directly under the tree's outermost branches, and the majority of roots are concentrated inside the drip line. To protect this area during construction, a temporary fence can ensure that no vehicles or other heavy equipment are parked or stored near the tree. Within this area, there should be no soil disturbance, including grading, trenching or paving. The "root protection zone" is larger and extends half again the distance from the trunk to the dripline. If it is absolutely necessary to place a ditch in the root protection zone, it is best to carefully hand-dig it or bore a tunnel under the roots. Once the construction activities are complete, this area should continue to be protected, and water-dependent species requiring extensive summer irrigation should not be planted there. It is especially critical that the ground near the base of the tree be kept dry during warm weather.

Regenerating Oaks

There is evidence suggesting that several species, including blue oak, valley oak, and Engelmann *(Quercus engelmannii)* oak are not reproducing at sustainable levels in portions of California. Simply stated, there are not enough young seedlings or saplings to take the place of mature trees that die, raising questions about the future of these species in the state. The reasons for poor regeneration are complex and depend on the site. Numerous causes have been cited, including increased populations of animals and insects that eat acorns and seedlings, changes in rangeland vegetation, adverse impacts of livestock grazing (direct browsing injury, soil compaction, and reduced organic matter), and fire suppression. Some people also suspect that climate change is a factor, and that oaks occupying the warmest and driest sites are having the most difficulty regenerating because conditions are becoming too harsh. Inventories have shown that the amount of natural oak regeneration is very site-specific. In some areas, abundant seedlings can be found, while in other locations, stands consist almost entirely of large trees. Even over short distances, the presence or absence of young trees can vary greatly.

Planting acorns or oak seedlings is often proposed as mitigation for tree removal or as a technique for reestablishing oaks in areas where they formerly grew. Establishing oak seedlings is not always an easy task, and the same factors that prevent or limit natural regeneration can also take a heavy toll on artificial plantings. To be successful, relatively intensive site preparation, maintenance, and protection must usually be provided for several years.

In addition to starting from acorns, many oak trees regenerate from stump sprouts following harvest, physical damage, or fire. In general, live oaks sprout better than deciduous oaks, and smaller trees tend to sprout more than larger ones. Stump sprouting has played a major role in reestablishing many oak stands. In many areas, a majority of the trees present originated from stump sprouts. Recent research has indicated that, for blue oaks, the season when trees are cut down has relatively little influence on sprouting. Taller stumps, 3 feet (0.9 m) tall, sprouted much more vigorously than those cut at ground level, though there is doubt whether sprouts originating from a tall stump will survive as long as those growing from the root crown. This study also found that in areas with large deer populations, protection from browsing was critical for long-term sprout survival (see McCreary et al. 1991).

The Planner's Role in Oak Conservation

Planners have a vital role to play in the conservation of oak resources. They can often view the consequences of a variety of activities that may impact oak resources and can provide a "global" assessment of these projects. They can also influence management decisions during project review and implementation by sharing information such as that contained in this publication. Oak biology, ecology, and regeneration combine a complex set of subjects that many people often do not have the time or inclination to consider. Unfortunately, failure to consider the implications of these planning options can result in diminishing oak resources. Understanding and applying the scientific disciplines associated with oak resource management in local and regional conservation strategies will help ensure that these strategies are sustainable in the long term.

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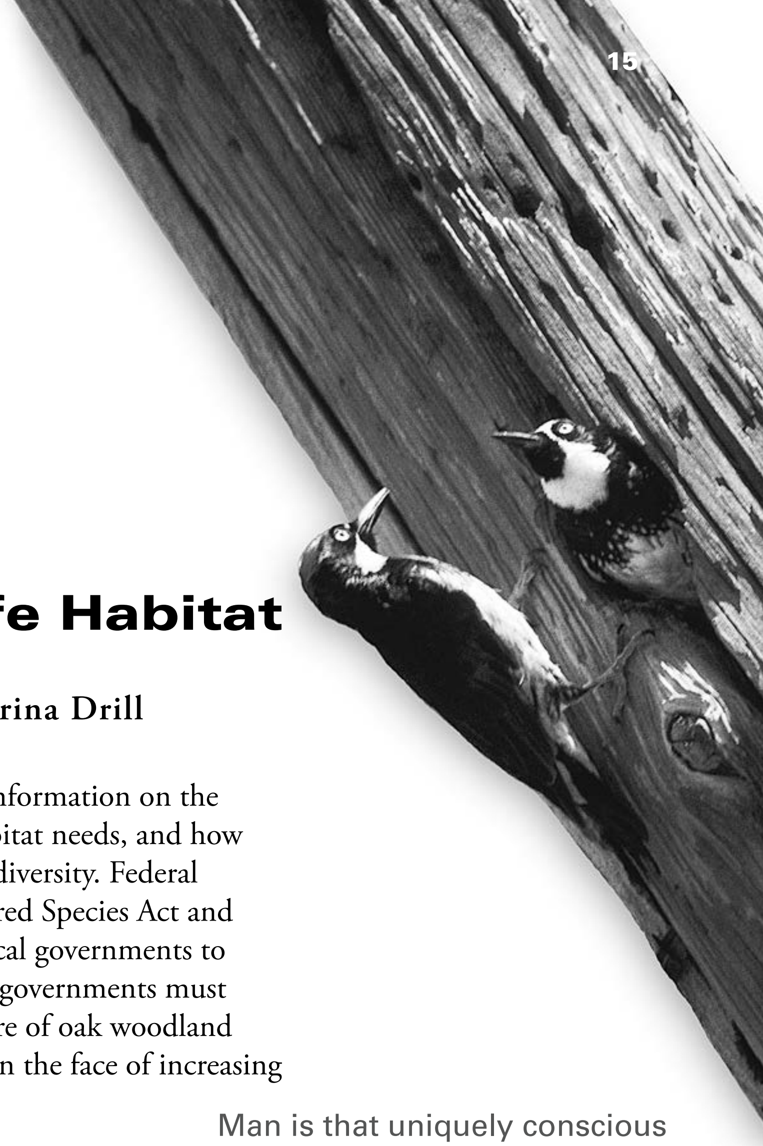


Chapter 3

Oak Woodlands as Wildlife Habitat

William Tietje, Kathryn Purcell, and Sabrina Drill

This chapter provides local planners and policymakers with information on the diversity and abundance of oak woodland wildlife, wildlife habitat needs, and how local planning activities can influence wildlife abundance and diversity. Federal and state laws, particularly the federal and California Endangered Species Act and the California Environmental Quality Act (CEQA), require local governments to include wildlife needs in land-use planning. Increasingly, local governments must account for the impacts of their activities on wildlife. The future of oak woodland wildlife depends on how we plan and manage oak woodlands in the face of increasing pressure from recreation and development.

Man is that uniquely conscious creature who can perceive and express. He must become the steward of the biosphere. To do this, he must design with nature.
—Ian McHarg

Habitat offers resident wildlife food, cover, water, and living space. California's oak woodlands are some of the richest wildlife habitat in the state. Of the 632 terrestrial vertebrates (amphibians, reptiles, birds, and mammals) native to California, over 300 species use oak woodlands for food, cover, and reproduction, including at least 120 species of mammals, 147 species of birds, and approximately 60 species of amphibians and reptiles. Each species of wildlife has different habitat requirements. For example, the band-tailed pigeon *(Columba fasciata)* consumes acorns and leaf buds, while the blue-gray gnatcatcher *(Polioptila caerulea)* gleans insects from oak twigs and foliage. The mule deer *(Odocoileus hemionus)* requires about a thousand acres of oak habitat to satisfy all its food, water, and cover needs, but the California mouse *(Peromyscus californicus)* uses less than an acre. Habitat needs of wildlife may also change with the seasons. The acorn woodpecker *(Melanerpes formicivorus)* eats acorns during fall and winter, but must forage for insects in spring to feed its nestlings. Similarly, the cover needed by wildlife during the summer may be much different than that required to survive in winter.

Habitat Structure

Habitat components found in oak woodlands are distributed both horizontally and vertically across the landscape. For instance, across the countryside, varying proportions of rock outcrops, shrubs, trees, and watercourses create a horizontal landscape mosaic of habitat patches of varying sizes, referred to as *horizontal structure*.

Within an oak woodland patch, several vertical layers of vegetation—canopy, shrub, and herb ground layers—are referred to as *vertical structure*.

Horizontal and vertical structure influences the kinds and numbers of animals that occur in oak woodlands. Generally, an oak woodland habitat with complex or well-developed horizontal and vertical structure supports a greater diversity of wildlife. Complex habitat structure increases the options available to animals. The wrentit *(Chamaea fasciata),* for example, feeds and nests in the shrub layer, and a woodland without a shrub layer will not support wrentits.

Horizontal Structure

Various land uses can alter the food, cover, water, and spatial components of habitat that wildlife require for survival. Many land-use practices and natural disturbances that alter the horizontal structure of habitat can lead to fragmentation when patches of habitat are created that differ from the surrounding habitat. The concept of habitat fragmentation comes from research conducted in eastern deciduous forested landscapes where two centuries of agricultural clearing and residential development have opened up (or fragmented) the once continuous forest canopy (fig. 3.1). In contrast, oak woodland is naturally patchy, and the classic concept of habitat fragmentation should be only loosely applied. The key element, however, is that oak woodlands can be altered in many ways, and the consequences for wildlife can be similar to what has occurred in eastern deciduous forests. Fragmentation that is caused by the construction of homes, road building, tree thinning, and heavy grazing in California oak woodlands can lead to invasion and population increases of undesirable non-native species such as the rock pigeon *(Columba livia),* English sparrow *(Passer domesticus),* and European starling *(Sternus vulgaris),* all introduced from Europe, as well as increases in native animals such as mule deer and raccoon (*Procyon lotor*) that often increase when open habitats predominate or when human presence increases.

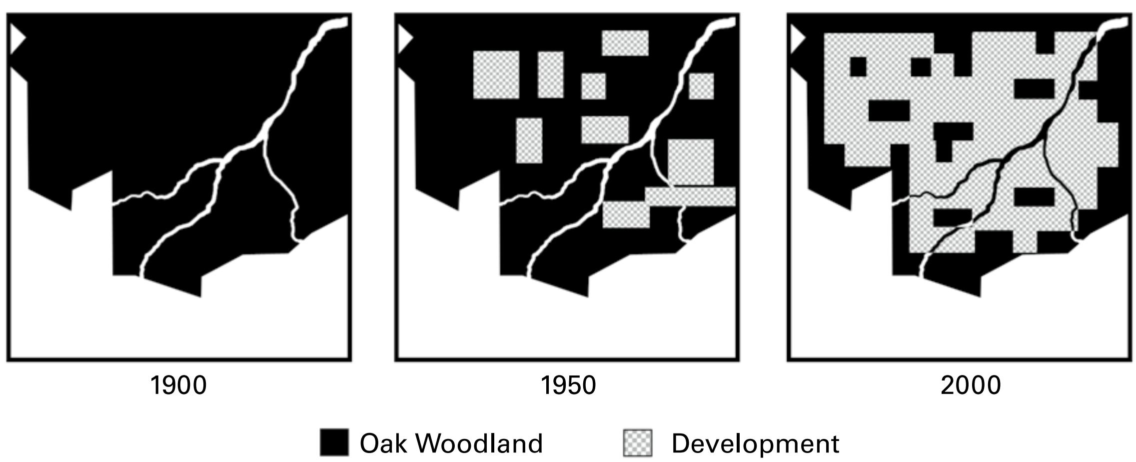


Figure 3.1. Hypothetical habitat fragmentation of an oak woodland patch over time (1900–2000) due to urbanization. The residual habitat mosaic in 2000 is greatly altered from the habitat of 1900.

Agricultural and residential development in oak woodlands does not always affect wildlife equally. Each species responds differently to changes in habitat, and regardless of the type of change, some species will benefit and others will suffer. For example, a study that sampled birds in oak woodland of northern-coastal California in three levels of development (ranchette, suburban, and relatively undisturbed rangeland) concluded that overall numbers and diversity of birds did not change, but bird composition (that is, the suite of species present) did (Merenlender et al. 1998). Specifically, the study demonstrated that more non-native species were found in the more intensively developed habitat, which likely reflected the change in vegetation (more non-native landscaping) and other elements of human presence such as roads, houses, pets, and noise. Presumably, a similar reduction within the other groups of vertebrates (small mammals, amphibians, and reptiles) that were not specifically assessed also occurred. Because these animal groups are, overall, less mobile than birds and more subject to the deleterious effects of roads, pets, and landscaping and garden poisons, we assume that numbers of individuals and the diversity of native species were reduced, similar to what occurred among the birds. Data from undeveloped blue oak–coast live oak woodland in coastal-central California support this supposition. Species diversity of small mammals, amphibians, and reptiles was greatest in the patches of woodland with high levels of vertical diversity (i.e., well-developed ground, shrub, and canopy layers; see Tietje et al. 1997).

California oak woodlands and associated animal species that are likely to be most affected by development as predicted by the habitat fragmentation model are those that most resemble well-structured Eastern deciduous forest, such as closed-canopy California coast live oak woodland, black oak woodland on moist sites, or oak riparian forest. These forests contrast with open-canopied blue oak woodland or valley oak savanna where the habitat fragmentation model may be less applicable. The model also applies better to areas with more intensive land use. Taken together, these results point to the importance of giving special attention in the planning process to coastal oak woodlands where pressures for development are especially great and where a new threat—sudden oak death—poses yet another concern.

Important landscape-level considerations when identifying features of oak woodland habitat that are often altered by land use include the number and size of habitat patches, the amount of edge, the continuity and configuration of habitat corridors, and barriers.

Patch size

Habitat occurs in what landscape ecologists refer to as patches. A patch is simply a distinct piece of habitat of a particular vegetation type and size. When habitat is modified by home building, vineyard development, or extensive firewood cutting, the number, size, and spatial arrangement of habitat patches on the landscape change. The residual patches have been likened to “islands” in a sea of development (see fig. 3.1). They may be too small or too isolated to provide resident wildlife the food, cover, water, and living space they need. The types of wildlife living in a patch are at least partly a function of how the habitat is altered as a consequence of land-use practices.

Edge

An edge occurs where two or more vegetation types meet. An example of a natural edge is the transition between woodland and grassland. The transition between woodland and an urban landscape or a vineyard would be an induced edge. A natural edge may result from gradients in soil type or topography, or from a fire or a windstorm. Induced edges result from land-use practices such as woodcutting, agricultural clearing, and residential development. Much study has addressed the effects of edges on wildlife in temperate deciduous forests of the eastern United States, where extensive clearing of the original contiguous forest has resulted in high edge densities. In eastern deciduous forests, there is greater light penetration and more human activity in forest edges than in forest interiors (i.e., away from edges). As a result, the understory is denser near edges and has a different composition of plant species than in interior contexts. Also, increased human disturbance results in edge effects that are usually deleterious to native wildlife.

Unlike eastern deciduous forest, California oak woodland is naturally patchy and edges are common even in the absence of human influence. While the primary constraint on vegetative development in eastern deciduous forest is light penetration, rainfall often limits plant growth in California oak woodlands. Because rainfall is similar across a patch, edges and interiors of oak woodlands in California are similar in vegetation structure and plant species composition (Vreeland and Tietje 2004). It therefore appears unlikely that natural edges in oak woodland have deleterious edge effects on wildlife.

Human disturbances, however, are similar in eastern forests and California oak woodlands. Agricultural and residential development in oak woodland results in the following induced edge effects:

- Increased human activity at edges increases fire probability.
- Dogs and cats kept as pets or released to become feral in wildland areas are harmful to native wildlife.
- Nest predators and species that thrive with human influence (such as raccoons and starlings) increase in edge habitat with deleterious effects on other animals.
- Weedy species of plants from agricultural fields, yards, and landscaping are carried into wildlands by wind, humans, pets, livestock, and wildlife. These invasive plants may displace native vegetation and eliminate habitat for native animal species.

For these reasons, land-use planning should seek to minimize the density of induced edges while maximizing undeveloped wildland habitat.

Corridors and connectedness

Strips of habitat that connect patches are called corridors. A corridor can be a strip of habitat that remains after disturbance, such as planting a vineyard, building a housing development, or cutting trees. Corridors may also be created by retaining or planting a strip of natural vegetation along a roadway or a greenbelt through a developed area. Some corridors occur naturally, such as the habitat along a stream or river (a riparian corridor).

Some wildlife species require habitat that cannot be met in a single patch of oak woodland and may depend on corridors in the landscape to connect several patches. Corridors can be crucial in maintaining interconnectedness between wildlife populations and providing suitable habitat for animals during migration. For example, mule deer in Northern California move in the fall from high-elevation foraging areas to lower-elevation foothill woodlands. It is essential that the deer have travel lanes of habitat (corridors) for protection and food during their journey. Some species are reluctant to enter or cross habitat that exposes them to predators or other hazards. Even a few oak trees connecting patches of oak woodland facilitate the movement and dispersal of some bird species, such as the oak titmouse *(Baeolophus inornatus)*. In some cases, maintaining even a few trees helps prevent the isolation of populations.

A connection between habitat patches can turn an otherwise isolated, unused patch into usable, occupied habitat. Although mountain lion *(Felis concolor)* populations in Southern California typically require approximately 625 square miles (1,600 sq km) of continuous habitat, the availability of connecting corridors allows lions to move into and between habitat patches that are small and therefore would not be used if not interconnected by the corridors. The connected patches can be sufficient cumulatively to maintain a lion population in an area where the large, continuous tracts of habitat have been fragmented by land use (Beier 1993). Oak woodland wildlife with large home ranges, such as gray fox *(Urocyon cinereoargenteus),* and bobcat *(Felis rufus),* also use corridors to move safely between habitat patches in search of food and water. The identification and conservation of corridors should be given careful consideration in the land-use planning process to minimize the adverse impacts of altering or fragmenting the oak woodland landscape.

Barriers

The opposite of a corridor is a barrier. Developments as seemingly harmless as a dirt road can disrupt the natural migration and dispersal patterns of animals. Unimpeded animal movements are important for the survival and reproduction of individuals as they seek food and mates. They are necessary to maintain the genetic health of populations. While dirt roads may sometimes be barriers, paved roads, especially major highways, definitely act as barriers. Highways and other roads with high traffic volume are significant sources of mortality and can serve as complete barriers to movement for many wildlife species. Several European countries have had great success with "greenways" that provide strips of continuous habitat either in underpasses or overpasses to facilitate movements and reduce mortality across large roadways.

In summary:

- Maintain large tracts of continuous oak woodlands (fig. 3.2A). Large tracts of woodland provide a variety of habitat elements and large populations of particular species; large populations are less likely to be extirpated than small populations. Large patches also minimize the amount of edge (fig. 3.3).
- A single large habitat patch is usually superior to several smaller patches, especially for vertebrate species with large territories or home ranges (fig. 3.2B). The importance of a variety of habitats for some woodland birds may argue for benefits of having many small fragments, but reproduction is often poor in small fragments because of predation by edge species of wildlife such as crows, raccoons, house cats, and skunks.
- To the extent possible, retain natural population levels of large carnivores in the system (fig. 3.2C). There is compelling evidence that coyotes *(Canis latrans)*, bobcats, and mountain lions limit numbers of smaller non-native predators such as house cats and red foxes *(Vulpes vulpes)* that prey on ground-nesting birds.
- Minimize human disturbance (fig. 3.2D). Excessive numbers of trails and roads through oak woodlands accelerate the invasion of weedy species and serve as barriers for some animals.
- Maintain or develop corridors to link habitat patches (fig. 3.3E). Corridors can ameliorate the deleterious effects of habitat fragmentation.

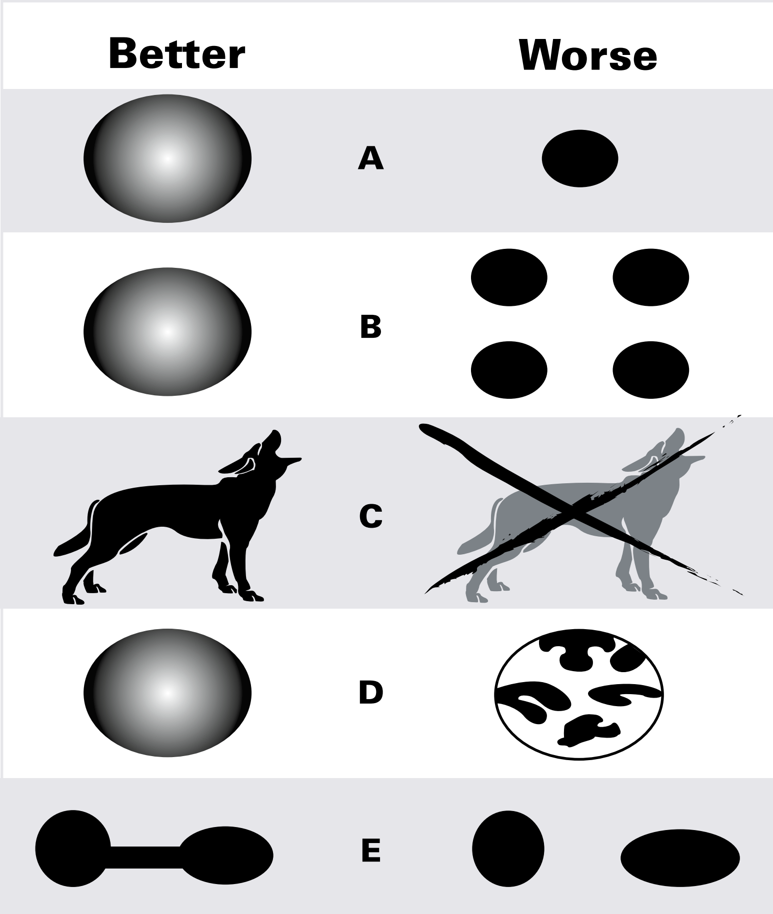


Figure 3.2. Summary of guidelines for maintaining horizontal habitat structure in oak woodland. *Source:* Adapted from Soulé 1991.

Vertical Structure (Structural Complexity)

Vertical structure in a woodland stand is made up of mature tree canopy, snags (dead standing trees), shrub layers, herbaceous ground cover, and downed wood. As more habitat elements are added to woodland, animal species diversity generally increases. Imagine looking into woodland from its edge. Woodland with only grasses on the woodland floor and large, living, mature oak trees of one species in the canopy is structurally simple. This same site, but with an additional species of tree in the canopy and with a few snags and a few pieces of downed wood, has more vertical structure, which encourages more animal species to use that area. Adding more layers of vegetation, especially several species of native shrubs (some producing berries), younger trees that are shorter than mature trees but taller than the shrubs, and more downed wood and snags in different decay states greatly increases the structural complexity of this woodland. Animals that require those habitat elements would correspondingly increase in abundance. Below are some important elements of horizontal and vertical structure and brief descriptions of how they influence wildlife.

Riparian habitat

Riparian habitat provides many of the needs of wildlife in a relatively small area. Water supports lush, diverse plant growth that provides food sources for herbivores and supports an abundant and diverse insect community. These vegetative and insect foods support species that eat them, which in turn support predators. Vegetation density and structure afforded by the trees and shrubs that grow in riparian areas provide protective cover. As a result, riparian areas are warmer in winter and cooler in summer than surrounding uplands. Riparian habitat also provides hiding and nesting cover for wildlife and corridors for safe daily and seasonal movements. For these reasons, oak-woodland riparian areas usually harbor greater numbers and kinds of wildlife than upland areas.

Land-use planners can maintain the wildlife values of riparian habitats by identifying these areas and protecting them with buffers along their edges. Because of the multiple ecological and political variables involved, it is unlikely that we will soon have a prescription for optimal riparian width. The width of the distinctive woody riparian vegetation serves as a guideline for determining buffer width. In riparian areas where the woody vegetation has been eliminated, the vegetation should be allowed to recover through protection and natural regrowth or restoration. Construction activities should be prohibited in riparian areas, and recreation, livestock grazing, tree cutting, and other possibly damaging activities managed conservatively.

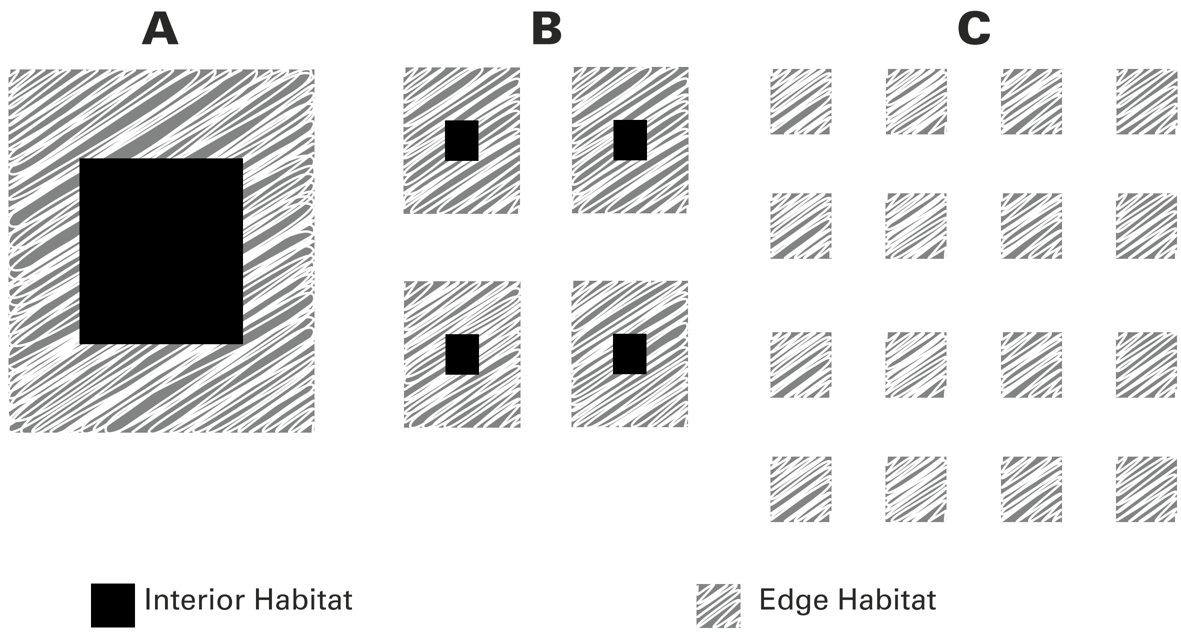


Figure 3.3. Breaking up large patches of woodland increases the relative amount of edge habitat. Here, a hypothetical woodland patch of 16 acres (6.5 ha) (A) was divided into 4 smaller patches of 4 acres each (B), and then subdivided into 16 1-acre patches (C). The relative amount of edge increases dramatically until the patch becomes all edge. *Source:* Adapted from Soulé 1991.

Fishes in Oak Woodlands

> It is a little-known fact that fishes grow on trees.
> —Pacific States Marine Fisheries Commission

Oaks and other tree species play an important role in controlling stream conditions necessary for native fish species to flourish (fig. 3.4).

Trees in riparian, or streamside, areas work to stabilize stream banks. Riparian trees shade streams, keeping water cooler; and masses of roots, called root wads, that emerge from the bank provide hiding places for juvenile and adult fish. This adds structure to a stream, creating pools of slower water where flow is blocked. These are important to many fish species, including migrating salmon and steelhead that need resting areas. Coarse woody debris can also add structure to riffle areas where active mixing brings oxygen into the aquatic environment.

Tree distribution in the landscape can influence the way streams cut through canyons and valleys, creating pools that give migrating or resident fishes a respite from rapid-flow areas. Healthy forests and woodlands in watersheds reduce sedimentation, which can affect fish negatively by reducing water clarity and degrading gravel stream-bottom habitat that is necessary for the successful development of eggs, especially of salmon and trout species. Removal of trees from a landscape alters watershed conditions.

The main factors that determine which fish live where are water temperature, gradient, and flow, along with the ecological history of the region. Oaks are found in a wide variety of geographic situations, including mountain canyons, valley floodplains, and coastal areas. A variety of fish species can be found in the lakes and streams that occur throughout the oak woodlands of California. In the Central Valley, the pikeminnow-hardhead-sucker assemblage of fishes occurs in foothill oak woodlands, where high-quality water flows through deep, rocky pools and wide, shallow riffles found in meandering, tree-lined streams. This ecological group of fishes is dominated by the Sacramento pikeminnow *(Ptychochelius grandis)*, the Sacramento sucker *(Catostomus occidentalis)*, and hardhead *(Mylopharodon conocephalus)*. Tule perch *(Hysterocarpus traski)*, speckled dace *(Rhynichthys osculus)*, California roach *(Lavinia symmetricus)*, riffle sculpin *(Cottus gulosis)*, and rainbow trout *(Oncorhynchus mykiss)* are also found (Moyle 2002).

Southern California streams have variable flows influenced by intense winter storms and spring snowmelt. Areas with warmer water can host California killifish *(Fundulus parvipinnis)*, threespine stickleback *(Gasterosteus aculeatus)*, arroyo chub

(Gila orcutti), and Santa Ana sucker *(Catostomus santannae)*. Areas that have cooler water and significant uninterrupted spring flows can play host to spawning runs of steelhead, a sea-run variant of rainbow trout.

Human alterations to streams affect aquatic habitat in ways that are similar to their effect on terrestrial areas. Dams, road crossings, and concrete channels can act as barriers to the upstream and downstream movements of fishes. Changes in land use in the watershed can impact water quality in a myriad of ways, including adding pollutants and changing temperature and sediment regimes. Many streams in California have been affected by the introduction of exotic species of invertebrates, amphibians, and fishes that impact native aquatic animals. Invasive species such as crayfish (Family Cambaridae), African clawed frogs *(Xenopus laevis)*, and bullfrogs *(Rana catesbeiana)* may eat the eggs and larvae of native fishes and amphibians, and their burrows in the stream banks alter the physical environment. Exotic fishes, such as mosquitofish *(Gambusia affinis)*, bass *(Micropterus* spp.*)*, sunfish *(Lepomis* spp.*)*, and carp *(Cyprinis carpio)* can also impact the physical and biological environments. Exotic plants, such as the giant reed *(Arundo donax)*, displace riparian forest. This can greatly impact the aquatic environment, for example, by reducing shade, altering flows, and increasing the risk of fire.

Activities that affect fish habitat are subject to a number of restraints through various environmental laws. If a stream provides critical habitat for an endangered fish, changes in land use within the watershed that cause alterations in flow or water quality may be subject to oversight from the federal or state Clean Water Acts or the federal or California Endangered Species Act. If this is the case, the project may require consultation with the U.S. Fish and Wildlife Service, the NOAA Fisheries, the Army Corps of Engineers, or the California Department of Fish and Game and the local Regional Water Quality Control Board. Activities may also need to be reviewed for compliance with the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA), and may require the submission of a statement of environmental impact. A good resource for information about permitting for any alteration or restoration work in watersheds or streams is the *Guide to Watershed Project Permitting* available from the California Association of Resource Conservation Districts Web site, www.carcd.org.

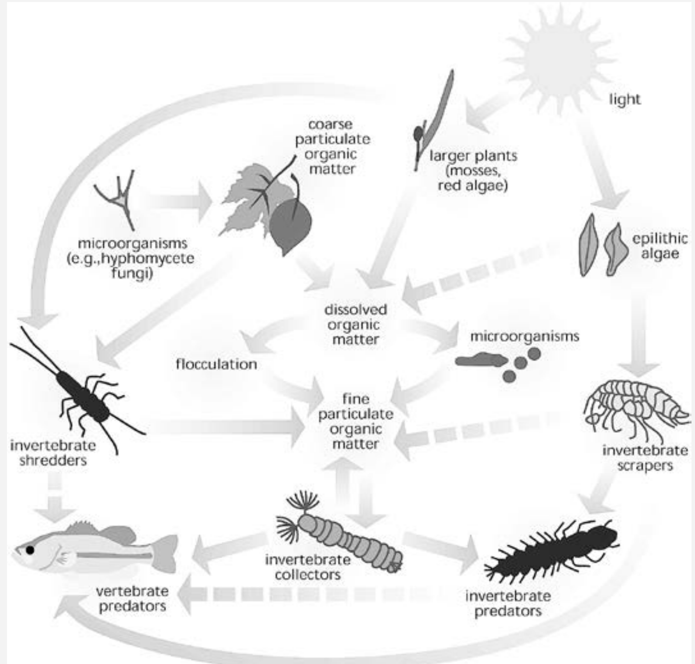


Figure 3.4. Relationships among elements of riparian areas. *Source:* FISRWG 1998.

The presence of fish habitat also provides access to sources of funds and technical assistance. Financial assistance is available from a variety of agencies, including the California Department of Fish and Game, National Fish and Wildlife Foundation (www.nfwf.org) and the National Oceanic and Atmospheric Administration's Community-Based Restoration Program (www.nmfs.noaa.gov/habitat/restoration/community). The California Department of Fish and Game and the California Association of Resource Conservation Districts (www.carcd.org) are good sources of technical assitance, as are your local RCD, NRCS, and Cooperative Extension offices.

Cavity trees

Cavity trees provide shelter and breeding sites for many oak woodland wildlife species. Most cavities in oaks occur in large, living, mature trees and are usually associated with wounds or dead branches. Northern flying squirrels *(Glaucomys sabrinus),* western gray squirrels *(Sciurus griseus),* raccoons, certain owls, bats, and certain amphibians and reptiles use cavities in oaks. A conspicuous group of animals that depends on tree cavities for reproduction are the cavity-nesting birds. These include the western bluebird *(Sialia mexicana),* acorn woodpecker *(Melanerpes formicivorus),* Nuttall's woodpecker *(Picoides nuttallii),* Lewis' woodpecker *(Melanerpes lewis),* Bewick's wren *(Thryomanes bewickii),* oak titmouse, tree swallow

(Tachycineta bicolor), violet-green swallow *(T. thalassina),* and ash-throated flycatcher *(Myiarchus cinerascens).* Some of these (the woodpeckers) are termed "primary cavity nesters" because they excavate their own cavities; the others, "secondary cavity nesters," use existing cavities (either excavated or naturally occurring crevices, holes, and hollows in trees).

Most excavated cavities are constructed in deciduous oaks such as blue oak, valley oak, and California black oak. Valley oaks, possibly because of their softer wood, seem to be preferred where they occur. In contrast, naturally occurring cavities, for example, those formed when the stub of a broken branch rots out and creates a hole in the trunk, are most abundant in the evergreen oaks (coast live oak, canyon live oak, and interior live oak). Older and larger oaks generally have more cavities than smaller or younger trees and therefore should be maintained to provide habitat for species that use cavities. Careful land-use planning is required to ensure a continued supply of trees with cavities. We recommend that unless they create a safety hazard, dead branches of live trees not be sawed off, as they may be important entry points for disease and fungi that facilitate excavation of nesting cavities.

Snags

Snags are trees that have died but remain standing. A host of different animals use snags. Snags are used as perching sites by raptors and other smaller birds. Reptiles, especially lizards, may use snags as basking sites in the summer and seek refuge under their bark in the winter. Crevices and rotting wood of snags are reservoirs for wood-eating insects, which are valued food items for many songbirds. If a snag has bark that is loose and sloughing off, bats, swallows, salamanders, and lizards can use the spaces between the bark and the trunk as roosts and hibernacula. For cavity-nesting birds, however, snags in oak woodland may be less important. In a recent survey, of 567 cavity nests of 10 bird species in blue oak woodland in Madera County, only 8 percent were in snags (Purcell 1995).

Downed wood

Downed wood is most important as resting and reproductive cover for amphibians, reptiles, and small mammals. Amphibians require moist structures and wet areas to keep their skin moist during dry periods. Because downed wood absorbs moisture during the rainy season and retains that moisture longer than smaller sticks, leaf litter, and grass, amphibians will lie against downed wood and wedge themselves between pieces of bark and the ground. Snakes and lizards also use downed wood in this way, as well as for basking sites. Small mammals construct nests in and against downed wood. Woodrats *(Neotoma fuscipes)* will build their houses in larger, hollow pieces of downed wood. Very large pieces of downed wood also can serve as rest and den sites for foxes, coyotes, and black bears *(Ursus americanus)*. Some species of ground-nesting birds, like dark-eyed juncos *(Junco hyemalis),* spotted towhees *(Pipilo erythrophthalmus),* and California quail *(Callipepla californica),* will place their nest against a piece of downed wood to offer more camouflage and greater protection from nest predators. Data from Madera County showed that house wrens *(Troglodytes aedon),* Bewick's wrens, acorn woodpeckers, ash-throated flycatchers, and mourning doves *(Zenaida macroura)* nested in areas with high cover of downed wood (Purcell and Stephens, in press). The two wren species especially appear to prefer areas with more logs for nesting.

Downed wood is mostly lacking over at least half of the oak woodlands in California (Tietje et al. 2002). Development project proponents and landowners should be encouraged to not "clean" woodland by removing all downed wood to create an open, parklike area. Leaving some downed wood provides an important habitat element for many kinds of animals. In addition, downed wood serves as a source of nutrients that can be released slowly back to the woodland during decomposition. It also may aid oak regeneration by providing physical protection for an emerging or growing seedling or sapling. Some suggestions include:

- Do not burn the limbs and smaller branches (slash) following firewood cutting. The slash can be piled on the stump or on the remaining large pieces to encourage stump sprouting and seedling recruitment.
- Concentrate removal of downed wood near the vicinity of structures and other buildings as part of a defensible space policy, and concentrate dead and down wood and slash away from roads and dwellings where the opportunity for a fire start is lessened.

Shrubs

Native shrubs, including toyon *(Heteromeles arbutifolia)*, redberry *(Rhamnus crocea),* manzanita (*Arctostaphylos* spp.), poison oak *(Taxicodendron diversiloba),* ceanothus (*Ceanothus* spp.), and coffee berry *(Rhamnus californica),* are important habitat components in oak woodlands. In addition to young oak trees, shrubs provide another level of vegetation intermediate between mature trees and ground-cover plants. This "understory" vegetation provides songbirds and small mammals protective cover from terrestrial predators like coyotes and bobcats, as well as from aerial predators such as hawks and owls. Woodrats and many species of wildland mice use shrub stems extensively as runways, rather than running along the ground. This provides them additional escape routes from terrestrial predators. Many of these shrubs produce berries that are used by birds and mammals as food. The addition of the extra layer and volume of vegetation also means greater surface area for invertebrates and, consequently, a greater diversity and abundance of songbirds that feed on woodland invertebrates.

Shrub cover is reduced following fire and was probably much reduced in the past in some areas due to burning by Native Americans and later by European settlers. Grazing also appreciably reduces shrub cover. Removing shrubs lowers the habitat complexity of oak woodlands. Animal diversity and abundance in woodlands can be enhanced by leaving and enhancing habitat for existing shrubs, and, if applicable, by planting native shrubs. Most oak woodland shrub species survive better and longer if they grow underneath a canopy of mature oak trees. Planted native shrubs should be given adequate but partial sunlight and room to expand. Watering and controlling competing annual grasses may be necessary for shrubs to become established, but extensive watering in summer may kill shrubs and trees. Obviously, when prescribing a suitable amount of shrub cover, the recommendation must be balanced with other planning considerations such as fuels management. Around a home, a shrub management scenario might include moderately spaced subcanopy plants intermixed with large cleared areas to create defensible space.

Acorns and acorn trees

All oak species produce flowers during spring. However, some oaks require 2 years to produce a viable acorn while others will produce nuts within 1 year. In both cases, acorns mature by September and October. Acorns are an important food source for many species of vertebrate and invertebrate wildlife. They provide important food resources for at least 45 wildlife species, including mule deer, California ground squirrels *(Spermophilus beecheyi),* western gray squirrels, acorn woodpeckers, western scrub-jays *(Aphelocoma coerulescens),* woodrats, many species of mice, and some insects. In turn, many of these small animals can be important prey for larger predators, including coyotes, bobcats, raptors (hawks, falcons, owls), and gray foxes. Through its effects on the population sizes of prey species, an abundant acorn crop indirectly influences populations of animals that do not directly use acorns.

Oaks, Acorns, and Woodpeckers

W. Koenig, University of California Hastings Natural History Reserve, and associates have published extensively on their work on the behaivor, ecology, and demography of the acorn woodpecker. Information for this sidebar was taken from Koenig et al. 1995.

The acorn woodpecker is a conspicuous resident of California's oak habitats. This bird has the unusual habit of excavating storage holes in old trees, called granaries, and storing large quantities of acorns in these holes in the fall. The woodpeckers then live off these acorns through the winter. Granary trees hold an average of 3,000 acorns, but an exceptional tree in the San Jacinto Mountains was estimated to contain 50,000 storage holes!

The habit of acorn storage goes along with a very unusual and interesting social behavior in this species. Acorn woodpeckers live in groups of up to 15 birds. The adults of a group are divided into breeders and nonbreeding "helpers." All adults generally help with storing acorns, raising the young birds, and defending their granary tree and surrounding territory from intruders.

The welfare of acorn woodpeckers is tied closely to oak trees and annual acorn production, although the birds also rely extensively on insects obtained by flycatching and bark gleaning. The availability of acorns during autumn and the storage capacity of the granary tree determine the winter food supply for the group. If many acorns are stored, survival through the winter is high and production of young in the spring will likely be more successful. Research at the Hastings Natural History Reservation in Monterey County over a 30-year period showed that four times as many groups with acorn reserves remaining in spring successfully raised young, compared to groups that had exhausted their stores. Some acorns are fed to the young birds, but the stores in spring primarily provide a food reserve that enables the adults to forage for insects, which are fed to the nestlings. In this way, the availability of acorns directly determines the number of acorn woodpeckers that occupy the oak woodland.

Few management practices have been developed to increase the production of acorns in the United States, though pruning has been used in Spain for centuries to promote mast production. Cutting trees or shrubs in dense stands of oaks may release suppressed trees and cause them to produce more acorns due to less competition for nutrients and water or better wind pollination. However, an increase in acorn production by a few residual trees may not compensate for the loss of habitat attributes from the trees that were cut.

Anthropogenic Effects on Habitat

Development and other human activities can have negative impacts on wildlife due to changes in the availability, abundance, and juxtaposition of habitat resources. A goal of land-use planning should be to minimize and mitigate these negative impacts.

Livestock Grazing

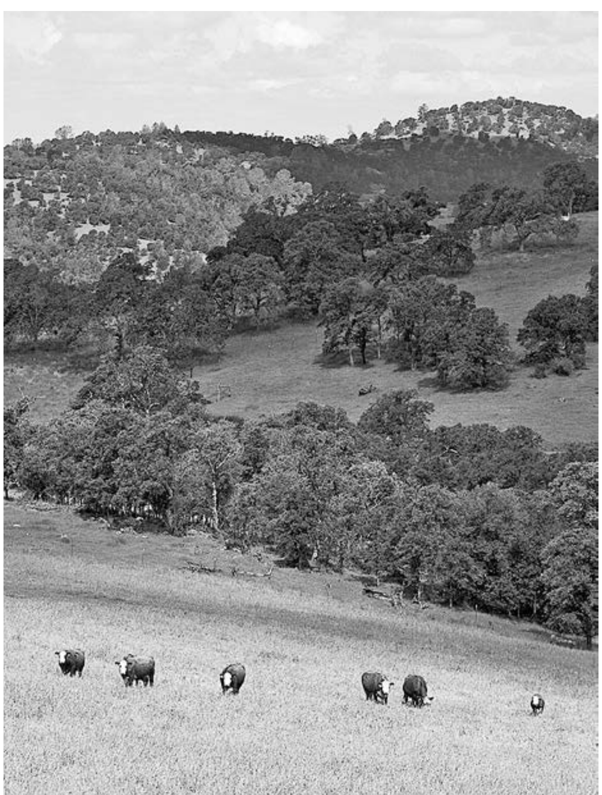
Ranching provides a mechanism for maintaining large expanses of wildlife habitat. Livestock grazing, when properly managed, can have far fewer negative effects on habitat than more intensive land management practices. Practices such as denying cattle access to riparian areas, making sure water troughs are properly placed and maintained, using weed-free hay when available, and protecting existing oak saplings can help ensure that woodland resources are conserved. When done well, livestock management creates relatively little disturbance to the natural system, yet provides long-term economic benefits to the landowner.

Intensive Agriculture

Intensive agricultural development can seriously impact oak woodlands and the resource values associated with them. Upland parcels, historically considered marginal or off limits for intensive agriculture, became subject to conversion for vineyard and orchard uses in the past decade. Concern about the effects of this type of conversion on the health and sustainability of the woodlands has prompted intensive research and education efforts. (Vineyard development and wildlife habitat management and maintenance are discussed in more detail in chapter 7.)

Urban Development

In California, increased demand for property in rural areas has raised property values and resulted in oak woodland modification or conversion (i.e., complete loss of habitat) to roads, recreational development, or residential use. The Fire and Resource Assessment Program (FRAP) estimates that during the 1990s, approximately 167,000 acres (68,000 ha) of oak woodland were converted from wildland to some level of residential use (1 or more houses per 20 acres). Furthermore, FRAP projects that in the next 40 years approximately 10 percent of California oak woodland (9.7 million acres, or 3.9 million ha) will be developed to some degree. The vast majority of this development has been, and is projected to be, with average lot sizes of 5 to 20 acres (2 to 8 ha) (Fire and Resource Assessment Program 2003). Exotic plants common in suburban and ranchette areas around houses and in residential gardens may not provide the habitat needs of native species. Non-native predators further impact the survival of native species. Bird species preadapted to a higher level of development, such as European starlings and rock pigeons, replace species that require more undisturbed habitat. Retaining large blocks of wild habitat and concentrating residential development in smaller, intensely developed, areas can help minimize the amount of habitat lost to development (see fig. 3.3). It can also make economic sense (see chapter 9).



Fire

For thousands of years, natural and anthropogenic fire have played an important role in oak woodlands of California. Frequent burning by Native Americans before European settlement resulted in low-intensity fires that maintained open stands of large oaks with little shrub cover, creating a fine-grained mosaic of vegetation patches. Following European American settlement in the mid-1800s, ranchers also conducted burns. Fire history studies indicate that average fire return intervals in oak woodlands in the late nineteenth to early twentieth centuries were from 8 to 15 years, at least in some areas. Fire suppression, begun in the 1940s and 1950s, increased surface and crown fuels, invasion of woody vegetation in the understory, and tree density. The effects of past fires are important to consider when making recommendations for wildlife species. Because these conditions existed for such a long time, they represent conditions under which species evolved and to which they are adapted.

Prescribed fire can be used to reintroduce fire into the ecosystem and to mimic historic fire regimes. Current land ownership patterns complicate prescribed burning plans in many areas, particularly those in urban-wildland interface areas. With careful planning and attention, however, low-intensity prescribed fires can be safely implemented and can achieve the desired results. Moderate- to low-intensity fires rarely kill mature oaks because their thick bark protects them from damage. However, even a low-intensity fire often kills the tops of seedlings, saplings, and small trees, though most will resprout from their base. Most scientific evidence indicates that typical oak woodland understory fires do not adversely affect the majority of terrestrial vertebrate populations. In an experimental fire that burned over approximately 50 percent of 500 acres (200 ha) of mixed blue oak–coast live oak woodland in central coastal California, there was no appreciable loss of canopy cover, shrubbery, or snags (Vreeland and Tietje 2002). Although grass cover was reduced by 70 percent and downed wood and woodrat houses by 30 percent, there were no substantial or long-term negative impacts to over 150 species of birds, small mammals, amphibians, and reptiles monitored 2 years before and 4 years after the fire.

A Fire Effects Information database is available online through the Rocky Mountain Research Station Web site at http://www.fs.fed.us/database/feis/. The database provides up-to-date information about fire effects on almost 900 plant species, approximately 100 animal species, and 16 communities of plants found in North America. The emphasis of each summary is fire and how it affects each species or community.

Wood Cutting

Cutting trees in oak woodland for firewood and to increase grassland area for livestock grazing has occurred since European settlement of California. It is estimated that from 1945 to 1985 firewood cutting and rangeland clearing occurred on 1.2 million acres (485,000 ha) of California oak woodland, mostly in blue oak woodlands. During that period, thinning occurred on nearly 62,000 acres (25,000 ha) annually. Research over the last 20 years has shown that in most oak woodlands, the multiple benefits of improved wildlife habitat, water quantity and quality, scenic watersheds, and increased property values that come with retaining oak trees far outweigh any short-term gains in forage production that may be attained by clearing. As a result, cutting trees for rangeland improvement has largely stopped.

Harvest Effects on Wildlife

Two studies (Garrison and Standiford 1997; Aigner et al. 1998) examined the effects of woodcutting on wildlife species composition and numbers. One of the studies used field data and habitat relationships models to evaluate the effects of firewood cutting. The other study experimentally removed oak trees and evaluated effects on birds using field data collected before and after removal.

Field Data and Model Assessment of Firewood Harvest

Impacts to wildlife from woodcutting at 19 sites in blue oak woodland in Shasta and Tehama Counties were assessed from vegetation data collected after the firewood harvest. Although the growth model projected that the average tree diameter at the woodcutting sites would remain approximately the same (10 inches, or 25 cm), tree canopy cover after 50 years would average 16 to 34 percent on the cut sites compared to 53 to 70 percent canopy on the uncut sites (Garrison and Standiford 1997). Given this scenario, habitat relationships models indicated that of 21 vertebrate wildlife species used to evaluate the cutting impacts, 1 species would be negatively affected, 7 species positively affected, and 13 species unaffected. Not surprisingly, species that prefer oak woodlands with more open canopy, such as mule deer, ash-throated flycatcher, and western bluebird, were predicted to benefit from the woodcutting. Negative effects of harvest were predicted only when the change in canopy from uncut to cut conditions was substantial. Recommendations to minimize harmful impacts of firewood harvest include the following:

- Cut trees of all sizes and leave disproportionately more large trees.
- Retain 25 to 40 percent canopy cover.
- Allow for tree recruitment through stump sprouting and production of seedlings and saplings.
- Retain habitat elements, especially shrubs, snags, and downed wood.

The authors caution that all predictive models have limitations and results should be tested and judiciously applied.

Effects on Breeding Birds of an Experimental Firewood Harvest

A pre- and post-assessment was conducted of the effects on breeding birds from an experimental removal of approximately 25 percent of the stems and basal area of mature oak trees (mostly blue oak and interior live oak) in low-elevation foothills of the northern Sierra Nevada. Nest cavity and granary trees were retained. Consistent population changes were detected in 12 species in the two seasons after harvest. Of these, 10 increased and 2 decreased: Hutton's vireo *(Vireo huttoni)* and Pacific-slope flycatcher *(Empidonax difficilis)*. Most of the species that increased on harvested study plots responded to the creation of brush piles after the harvest. Two of the others that increased—western kingbird *(Tyrannus verticalis)* and Bullock's oriole *(Icterus bullockii)*—were clearly linked to the more-open stands of oaks that were created by the harvest, while the decrease in numbers of Hutton's vireos and Pacific-slope flycatchers was associated with the reduction of canopy cover. The authors concluded that small-scale firewood harvests with low levels of removal (< 25 percent) and retention of cavity trees would likely have minimal effects on most of the more common breeding birds. Effects on the more rare species could not be determined; further research is needed.

Planning Considerations

Historical records reveal that the first European settlers that viewed California oak woodlands saw a land of abundant wildlife and other natural resources. In spring 1844, John C. Frémont reported that by the Tuolumne River in Tuolumne County the beauty of country "had been increased by the additional animation of animal life; and now it is crowded with bands of elk and wild horses; and along the rivers are frequent fresh tracks of grizzly bear, which are unusually numerous in this country" (Frémont 1970, 661). During the past 150 years, the introduction of exotic plants and animals, agricultural conversions, cutting oak trees for fuel and to increase forage for livestock, suppression of fires, and, especially in the last 25 years, development, have left a landscape much different from that viewed by the first European settlers. Vision and creativity are needed to maintain the economic and ecological viability of remaining landscapes. The remainder of this chapter briefly summarizes several ideas and techniques that may be helpful to integrate wildlife considerations into the land-use planning process.

Species Richness versus Selected Species Considerations

There are two possible approaches in planning for wildlife:

- plan for the habitat requirements of as many species as possible, known as "species-richness planning"
- plan for the habitat needs of particular species, known as "selected species planning."

Here we will focus on planning for species richness. Sources of information on managing for specific wildlife species and ranch management goals are given in the bibliography. Of course, most oak woodland habitat is owned by ranchers who must consider livestock production and other range-management goals in conjunction with maintaining habitat for wildlife.

Wildlife species richness can be promoted by maintaining a range of tree species with differing size and stages of vigor in close proximity. It is important to identify and maintain unique and special oak habitat components such as riparian areas, cavity trees, downed wood, and good acorn-producing trees. One should also try to maintain large blocks of contiguous oak habitat where components are represented in sufficient quantities and juxtapositions. The importance of maintaining corridors and connectedness increases as the size of the habitat block decreases. A habitat corridor through a developed area not only increases numbers and kinds of wildlife, it also enhances the aesthetic and economic value of the area. Wildlife professionals can assist in developing specific plans to meet wildlife goals.

Design Considerations: Fitting Development to the Land

Several ideas for designing development on the lot, individual project, and landscape scale are listed below. Some of these design considerations can also benefit crop and livestock production and thus help preserve agriculture and open space which, in turn, may benefit wildlife.

Lot design

Large lot sizes (that is, low density) maintain more habitats for wildlife than small lots. However, even with low lot density, high-density use, such as recreational horse use with accompanying barns and sheds and high animal impacts, may have a greater impact than what was originally planned.

Project design

Cluster development is a form of high-density development that concentrates construction in one portion of the development site, perhaps where adverse impacts on wildlife would be least. In this way, the remainder of the development site can be designated as open space for recreational use and wildlife habitat. For example, a cluster-development design was used to maximize maintenance of open space at a 3,100-acre (1,250-ha) site in oak woodland located near San Luis Obispo. An 800-acre (320-ha) piece was divided for 48 lots. The remaining 2,300 acres (930 ha) were dedicated to ranching, recreation, and other low-disturbance land use with minimal adverse impacts on wildlife.

Another consideration is the shape of a development site. Should it be circular or elongated? Because wildlife moving through woodland or flying over it are more likely to come into contact with a long, narrow development oriented perpendicular to their line of travel, it is generally better to concentrate developments in circular areas. Shape and size of the project are only part of the design considerations. The size of the planned area has traditionally included only the area slated for development. However, several of the larger oak woodland birds and mammals move across thousands of acres in pursuit of their life needs. Chapter 5 examines the nuances of regional and landscape-level planning considerations.

Landscape design

Generally, most land development in oak woodlands has occurred on parcels ranging in size from 1 to 40 acres (0.4 to 16 ha). Management by watershed or landscape units is a more ecologically sound approach. Management at that scale provides a mechanism for local planners to integrate wildlife values with other resource values such as air, water, agriculture, and open space. In this way, areas of adequate size and connectedness can be maintained for all wildlife.

The political climate in California today and available information technology makes planning for wildlife feasible on a regional or countywide basis. Cumulative effects of many small developments can and must be addressed at the largest spatial scale possible. Examples of how to maintain wildlife in the planning process are given in Adams and Dove 1989.

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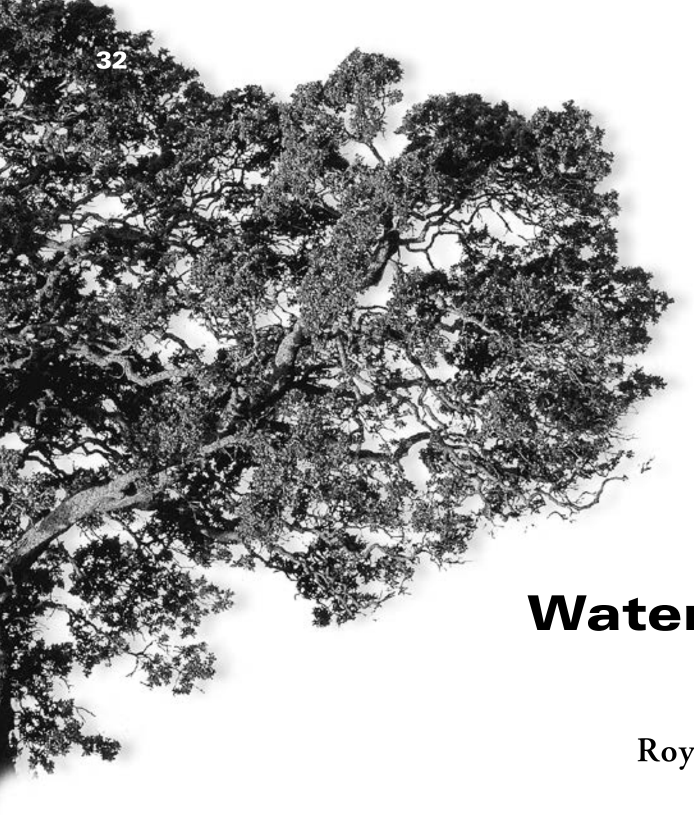


Chapter 4

Watershed Management in Oak Woodlands

Royce Larsen, David Lewis, and Yana Valachovic

What Is a Watershed?

Watersheds are geographic areas associated with a stream or river and the surrounding uplands and tributary channels that drain to it. The term *watershed* is synonymous with a catchment or drainage basin; in Great Britain and in Germany terms like *drainage divide* or *water parting* are used to describe the ridgeline borders around a watershed. No watersheds are alike. Some range in size from tens of square miles, like the Pajaro River and the Los Angeles River Basins, to several thousand square miles, like the Sacramento River and Russian River Basins.

A watershed can extend over several jurisdictions, including counties and states. For example, the Klamath River watershed includes land in several counties of California and Oregon. Watersheds may include several plant communities consistent with changes in elevation, slope, and aspect. For example, many rivers found in the Sierra Nevada have headwaters in conifer forests, with channels that traverse different downstream vegetation types and ultimately pass through oak-dominated foothills and valley woodlands.

What Is a Stream?

There currently exist several different stream-classification schemes that can sometimes be confusing because they are based on differing and potentially conflicting criteria and objectives. At the most general level a stream is any well-defined channel with a distinguishable bed and bank showing evidence of having contained flowing water. Other ways to describe or graphically depict streams include:

- Streams may be classified as perennial, intermittent, or ephemeral on the basis of flow regime. A perennial stream flows all year. An intermittent stream flows during and for a period following rainfall or snowmelt. An ephemeral stream only flows in direct response to storms.
- On USGS topographic quadrangles, perennial streams are indicated as solid blue lines. Intermittent streams are indicated as dashed blue lines. Ephemeral streams, and in some cases intermittent streams, are not indicated except by evaluation of topographic lines.

- California's Forest Practice Rules (FPR) and the State Water Resource Control Board (SWRCB) categorize streams into classes from 1 to 4. Class 1 is a fish-bearing stream; Class 2 contains aquatic life or is within 1,000 feet of a class 1 stream; Class 3 streams have the ability to transport sediments; and class 4 streams are man-made watercourses.
- Watershed research often uses a scheme that classifies streams based on their order of magnitude from 1 to 6, with first-order streams being the smallest and sixth-order streams being large rivers. This system provides a relative ranking of streams indicating channel position and size in a watershed.
- The Rosgen stream morphology classification system uses discrete classes for a suite of morphologic parameters to categorize stream types. Discrete categories help create consistent, reproducible rules for inclusion of a stream in a stream type. This stream typology is used by the California Department of Fish and Game (CDFG) and other agencies for assessing stream condition.

Classification of woodland streams can be confusing because in some cases streams are intermittent but can support fish during certain seasons of the year. Consultations with representatives from the California Department of Fish and Game and/or the Department of Forestry and Fire Protection (CDF) may be necessary to alleviate any confusion. Do not solely rely on map information to find and identify streams.

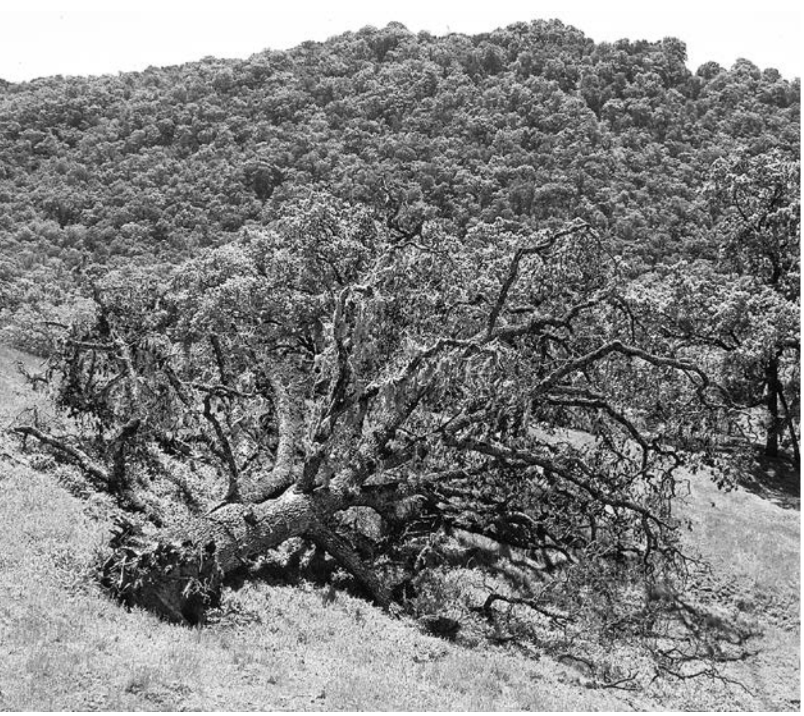
Hydrologic Cycle

Water is the driving force of nature. It is the essential medium of the biogeochemical cycles (water cycle, energy flow, mineral cycle, and nutrient cycle) and of life itself. The development of sound management practices that protect watersheds and provide needed water require a clear understanding of hydrologic processes. The primary hydrologic functions of watersheds are to capture, store, and safely release water. Water is captured when it falls to the soil surface as precipitation (fog, rain, and snow) and infiltrates into the soil profile where it moves slowly, recharges groundwater supplies, and eventually is released into streams. Usually, during the wet winter season and more intensely during storms, the storage capacity in watersheds is exceeded, resulting in increased release of water to stream channels. Many streams in oak woodlands are intermittent, with the watershed usually requiring 6 to 10 inches (15 to 25.5 cm) of precipitation to initiate stream flow. The amount of precipitation required to saturate, or prime, a watershed is a function of the underlying geology, soil depth, and soil water-holding capacity.

While the volume of precipitation falling on oak canopy versus open grassland is similar in a watershed, the capture, storage, and release of that precipitation is very different. Oak canopies can intercept 20 to 30 percent of annual rainfall that is not intercepted by grasslands. In addition, oaks serve to increase the water-holding capacity of the soil through increased contributions of soil organic matter. Also, more water is lost through transpiration in oak woodlands than in grasslands. As a result, generated stream flow volume or water yield from grassland-dominated watersheds is greater than from those dominated by oak woodlands. A 10 to 15 percent increase in water yield has been observed following conversion of 90 percent of a watershed area from oak-dominated woodlands to grasslands, while a conversion of 14 percent of the watershed area resulted in no observable change. Increased water yield can also transform an intermittent stream to a perennial stream.

Once saturated, excessive water that does not infiltrate into the soil flows over the surface. As water concentrates on the surface, it increases in mass (coalescing into larger volumes) and velocity as it moves toward a stream. With every incremental increase in mass and velocity there is an increase in the kinetic energy associated with the runoff. Activities that increase surface runoff therefore increase water velocity and kinetic energy (kinetic energy is equal to one-half mass times velocity squared; for every doubling in velocity, kinetic energy is squared). This increase in energy can activate erosion processes.

During storm events, the conveyance of additional water in shorter periods of time contributes to increased peak stream flow and possibly flooding. Within a stream, increased water volume increases flow rates; through fluvial processes, the increased flow rate translates to increased ability to transport sediment. Results may include changes to stream channel morphology (shape), including a change in channel depth and width.



Nutrient Cycling and Sediment Transport

Physical processes have been actively shaping watershed topography and in-stream conditions for millions of years. These processes include erosion, transport, and deposition of sediment in lower elevation floodplains, river deltas, and estuaries.

Water is the key factor affecting each process, and it plays a major role in the surface and subsurface transport of nutrients and sediment. Typically runoff from oak-dominated watersheds carries 1 to 2 pounds (0.45 to 0.9 kg) of nitrate nitrogen per acre per year, a range from about 500 to 1,200 tons per square mile per year (175 to 390 T/sq km/year). Though annually variable, this process is regulated by a dynamic steady state between vegetation, soils, geology, and atmospheric deposition.

Erosion

Erosion is the detachment, transportation, and deposition of soil particles. It is a function of erosivity (the energy of the water acting on the soil) and erodibility (the physical characteristics of soil). Natural, or geologic, erosion results from climatic and topographic conditions and is independent of human activities. Accelerated erosion is an increase in soil erosion as a result of human activities that alter the vegetation cover or change the physical properties of the soil.

Plant cover protects against splash and sheet erosion by absorbing the energy associated with raindrops before they hit the ground. Vegetative cover also helps by inhibiting surface flow, slowing its movement across the soil and increasing infiltration.

Physical properties of the soil such as texture (sand is more easily detached than clay, but clay particles are more easily transported), aggregate stability, bulk density, topography, type of land use, and type of vegetation also play an important role in infiltration. As vegetation decomposes it adds organic matter to the soil, improving aggregate stability and decreasing bulk density, making conditions favorable for increased infiltration. Any activity that removes too much vegetation, such as tillage, grading, road building, overgrazing, or fire, exposes the soil surface to increased erosion. Activities that decrease aggregate stability and increase bulk density (i.e., trampling by animals and compaction by equipment) also decrease infiltration and increase erosion.

Other compacted bare surfaces such as roads have been identified as major sources of erosion. Management activities such as rolling dips and properly sloped and drained roads and trails help decrease accelerated erosion. Proper size and installation of culverts is also necessary to help decrease erosion. Water concentrates and increases erosive energy in areas that have bare or compacted soil such as overgrazed areas, road surfaces, tire tracks of vehicles, or cattle trails. Once water is concentrated, passing through culverts may further increase its erosive force.

Leaving proper amounts of vegetative cover decreases surface runoff and erosion. Referred to as residual dry matter, RDM is the plant material left on the soil surface at the beginning of a new growing season from the previous year. The amount of RDM left in the fall influences species composition and productivity the following year. It is also a key factor in watershed protection. The minimum recommended RDM guidelines range from 300 to 2,100 pounds per acre (55 to 384 kg/ha) depending on soils, slope, and the percentage of woody cover. Your local Resource Conservation District (RCD) or UC Cooperative Extension office can assist in developing RDM thresholds in a particular county.

Oaks and Watersheds

Oak trees create islands of enhanced soil fertility in comparison to adjacent open grasslands. Annually, individual oak trees generate three to five times more litter than open grasslands. The result is deposition of two to three times more organic matter under an oak canopy and 35 to 40 percent more organic carbon and nitrogen in soils under an oak canopy than in grassland soils. Similar differences in deposition and soil enrichment exist for other nutrients such as phosphorus, potassium, and calcium.

Watershed conversion from one vegetation type to another can disrupt nutrient cycling processes and expose soil surfaces to erosion, which influences stream water nutrient and sediment concentrations. When an individual tree is removed and a site transitions to open grassland, soil nutrient concentrations decrease to those of grassland soils. This transition spans approximately 10 to 15 years until a new steady-state soil nutrient cycle is established. Nutrient losses during the transition period can occur through grazing, chemical and biological soil processes, and hydrologic export.

Increased nutrient concentrations in stream water following vegetation conversion are a function of the size of the watershed area experiencing conversion and the manner in which the conversion occurs. For example, complete landscape disturbance by fire or vegetative removal delivers nutrients to stream water more rapidly than selective removal of individual trees with methods designed to reduce water-quality impacts. Increases in stream water nutrient concentrations generally subside within 3 to 4 years after conversion. Similarly, vegetation conversion can increase sediment concentrations in stream water. Many factors play a role in the level and duration of sediment transport, including watershed geology and soils, geographic location, the area of watershed converted, and the methods of conversion. For example, the conversion of approximately 90 percent of a Sierra Foothill oak-dominated watershed to grassland resulted in a near-doubling of sedimentation, compared to a ten-fold increase in sedimentation after a similar level of conversion in a coastal watershed with similar vegetation. The primary difference between the two sites was the underlying geology and soils, with the coastal watershed on more erodible marine sediments and the Sierra foothill watershed on metavolcanic rocks that are relatively resistant to erosion. Additionally, in the case of the coastal watershed, erosion rates can potentially increase 5 to 10 years following the conversion due to mass-wasting events associated with the decay of tree and shrub roots.

To maintain a properly functioning watershed, soil formation must equal or exceed soil loss (natural erosion). As runoff and erosion increase, less water is retained in the soil. This may lead to less water and nutrients being available to support the plant growth necessary to protect the soil from erosion. In severe instances, soil erosion can reach a critical point where natural processes of revegetation and soil stabilization cannot be reversed. Three main principles that should be followed to help slow or prevent soil erosion:

- Keep adequate soil cover.
- Slow water down where possible.
- Spread water out, preventing it from concentrating.

Emerging Watershed Policies

Increased nutrient export resulting from conversion of oak woodland to grasslands may contribute to eutrophication (decline) of streams, lakes, and estuaries, resulting in low oxygen concentrations that are unsuitable for many aquatic organisms. Increased sediment transport can cause siltation of stream gravels and increased sedimentation and turbidity of rivers, lakes, and estuaries. Understanding the influence of watershed geology and soils, the area of watershed conversion, and conversion methods facilitates management decisions that reduce the impacts on water quality and aquatic habitat.

Accelerated transport of sediment and nutrients into water from wildlands is classified as non-point source (NPS) water pollution. The management of NPS has become, and will continue to be, a major focus of resource agencies responsible for protecting California's waters. Current state and federal water laws are designed to protect the integrity of the state's waters by protecting all of its recognized beneficial uses. Beneficial uses include domestic, municipal, agricultural, ecological, recreational, and navigational uses of streams, lakes, estuaries, and ground water.

Regional water quality control boards throughout California are responsible for designating the beneficial uses of water and have the jurisdictional authority to implement measures to address and mitigate NPS. If the beneficial uses of any water are impacted, for any reason, the water body is classified as impaired. Once classified as impaired, a plan must be developed to mitigate the pollutant. For more information on these regulations, refer to the State Water Resources Control Board's Non-point Source Program Strategy and Implementation Plan or contact the California regional water quality control board in your area to learn more about local programs and policies.

Working with Watershed Groups

The traditional way of describing a watershed usually depicts a geophysical area where all the water drains to a central stream, river, or lake. As the water moves downstream in a watershed, activities such as road building, water withdrawals, and vegetation removal can affect the quality, quantity, or rate of water movement and can change the conditions of the watershed downstream.

Another description of a watershed would be to simply call it a neighborhood. Since even a small watershed can include several hundred acres, few people often own the entire acreage contained in the geographical definition of a watershed. Though adjoining landowners may not see each other, as may be the case in a suburban neighborhood, they share many of the natural resources and services provided by the geophysical features of a watershed. Hence, all the landowners in the watershed are intrinsically connected to each other through the geophysical space they share.

Ownership patterns, combined with individual landowner goals and objectives, are the primary basis of resource conflicts throughout California. The resulting clash is a direct consequence of recent demographic changes driven by the urban exodus into rural communities. Resource conflicts often arise over values and attitudes toward resource extraction and use versus resource protection and preservation. In these cases, although adjoining landowners may share a geographic space, their economic, social, and political expectations for the area may be vastly different. This fundamental difference in perspectives is crucial to understanding how communities become polarized over resource issues.

It is for these reasons that many watershed residents (neighbors) have come together to address and resolve resource issues through the formation of watershed councils, stewardship groups, and various other coalitions. The commonality among these groups is the recognition that if neighbors collaborate with each other they can collectively have positive influences on the functionality and integrity of the watershed.

Watershed organizations offer an effective, voluntary means for landowners to address complex landscape issues in a proactive way. These issues may range from salmon recovery to fire and fuels management. Watershed associations are also able to respond to emerging issues such as the federal listing of rivers for total maximum daily load (TMDL), general plan updates, and zoning debates by providing a mechanism for providing a consolidated point of view to local decision makers. They can also address road improvements, noxious weeds concerns, coordination of water diversions, plans for droughts, or even economic sustainability goals. These types of associations often provide a mechanism for a group of landowners to develop trust and communication among stakeholders (usually residents, but possibly also state or federal agencies or tribes) in a way that helps develop awareness and coordinated plans.

Additionally, watershed groups may position themselves for funding by developing a 501(c)(3) nonprofit organization or collaborating with existing nonprofits (e.g., resource conservation districts, land trusts, etc.), to satisfy eligibility requirements for state and federal funding. Resource allocations may target improvements such as sediment reduction, stream enhancement, riparian fencing, and fire planning and fuels reductions efforts. Some county RCDs (Trinity, San Diego and Lake) have even developed resource management guidelines to assist local watershed groups in better addressing best management practices (BMPs) that serve as an additional reference for local planners.

Watershed associations vary from informal road associations to highly structured nonprofit landowner associations; regardless of their structure, they offer planners several important resources:

- They have lists of cooperating landowners who have expressed a willingness to address sensitive resource issues and are willing to take an advocacy role in expressing those concerns.
- They provide a source of local knowledge about past and current practices in the watershed and often contain the best on-the-ground understanding of the conditions of the watershed and specific goals for watershed improvements that have community support.
- Some watershed groups may have developed strategic resource plans that address landscape issues in a unified approach, potentially circumventing hours of contentious public debate and redirecting energies to addressing oak woodland management goals.

Watershed associations often meet regularly, and their meetings are usually open to interested parties, affording a ready audience for a planner to address. Specific activities that a planner should consider for soliciting a watershed group's input might include:

- assistance with the development of area plans as part of a general plan update
- a forum for seeking public input to an on-going planning issue
- a venue for presenting the results of surveys, questionnaires, proposed planning documents, etc.
- an opportunity to engage multiple stakeholder input to comply with the California Environmental Quality Act

Planners can usually secure contact information for local watershed group coordinators by contacting resource conservation districts, Natural Resources Conservation Service (NRCS) offices, or their local county UC Cooperative Extension office.

Summary

Individual oak trees play a significant role in the nutrient and hydrologic cycles that influence watershed functions. Oak trees in a watershed increase evapotranspiration and decrease water yield in comparison to grassland-dominated watersheds. In addition, oak trees return more litter biomass to the soil, resulting in higher soil nutrient levels than in watersheds without oaks. As a result, nutrient cycles and the relationship between rainfall and water yield are in balance on an annual basis. However, conversion of oak woodland to other vegetation or complete removal of oak woodland during development can disrupt this balance and result in increased water yield and reductions in water quality. The scale and duration of these changes depends on watershed geology and soils, the area of vegetative conversion, the mechanism and timing of tree and wood removal, and the regeneration of oaks and other vegetation types. Data suggest that conserving oaks as a component of these ecosystems enhances soil and water quality and contributes to the functioning of California's oak woodland ecosystems.

Technical help and information on these concerns is available from your local Natural Resources Conservation Service, resource conservation district, and UC Cooperative Extension offices. Many areas have established watershed workgroups, which may be helpful as well.

Chapter 5

Regional Planning as a Strategy to Address Conservation Goals

Thomas Scott and Gregory A. Giusti

Oak Conservation by Individual Land Units

Traditional planning mechanisms have focused on individual trees or woodlands on individual properties. These management approaches cause oak resources to be altered in a piecemeal fashion, with less than adequate thought given to comprehensive regional goals. As a result, most planning decisions for oak woodlands depend on the discretionary decisions of individual planners through the review process.

As previously mentioned in chapter 1, shifting demographics in California during the past two decades has resulted in a large number of landowners moving into wildland areas. These exurbanites, once relocated, became concerned with rapid increases in housing construction and subsequent conversion of wildland acres and sought relief using the California Environmental Quality Act (CEQA) to try to minimize the negative impacts of sprawl. Frustrated by some of the inherent shortcomings of CEQA to address issues beyond the project level, many citizens look to the federal Endangered Species Act (ESA) to protect wildlands by listing and protecting individual species.

Various innovative regional planning vehicles have been developed in the effort to control development in wildlands, including open space districts and multiple species conservation plans (MSHCP). These alternatives have helped a number of municipalities develop mechanisms for maintaining woodland ecosystems at larger scales, even if few of these mechanisms have specifically identified oaks as part of their conservation strategy.

Why Regional Planning?

Spatial or regional planning offers the opportunity to undertake a broad-based ecosystem approach for protecting and perpetuating biological diversity through the collaboration and cooperation of numerous private and public partners. Through regional planning, communities can identify and protect plants, animals, and their habitats, and they can also come to recognize that the natural distribution or dispersal of these plants and animals does not subscribe to jurisdictional boundaries.

It also provides a mechanism to accommodate compatible economic activities. Once considered a radical approach to land-use planning, spatial planning is gaining mainstream acceptance as a viable vehicle for conservation planning.

For example, a multipronged regional habitat conservation effort in San Diego County (fig. 5.1) addresses multiple species habitat needs across multiple ownerships,

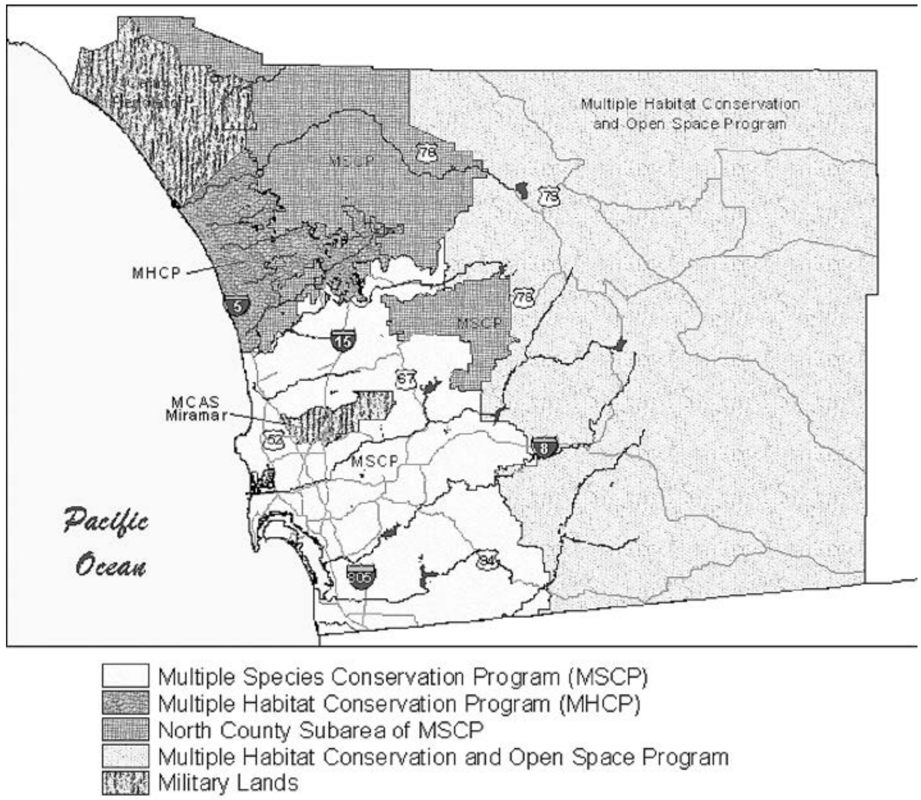


Figure 5.1. A multiple-agency collaborative spatial planning effort in San Diego County. *Source:* San Diego County Department of Land Use Plans.

including an amalgamation of Department of Defense lands. The U.S. Department of Fish and Wildlife sponsored a multiple species conservation program (MSCP) in conjunction with the California Department of Fish and Game's Natural Community Conservation Plan (NCCP) effort to preserve native vegetation communities in a 900-square-mile (2,300-sq-km) planning area in southwestern San Diego County.

The MSCP plan was completed in 1998 and identifies 171,917 acres (69,575 ha) of open space for conservation. Contained in the planning area is over half of all remaining natural habitat areas (167,667 acres, or 67,855 ha) in the county and 4,250 acres (1,720 ha) of other open spaces (such as disturbed and agricultural lands) that contribute to conservation objectives.

Each local jurisdiction and special district is responsible for implementing their respective portions of the MSCP through subarea plans that describe specific implementing mechanisms for the MSCP. Collectively, the subarea plans contribute to the conservation of vegetation communities and dependent species in the MSCP planning area. The combination of the MSCP and the subarea plans serve dual purposes: a multiple-species habitat conservation plan and a natural community conservation plan, pursuant to federal and state endangered species laws. The conservation measures specified in the MSCP provide for "coverage" of 85 species of plants and animals ("covered species") under the state and federal endangered species laws. The MSCP also contains a management program to maintain habitat quality for covered species and establishes a subregional biological monitoring program to gauge the progress of the program toward meeting its biological objectives.

The Endangered Species Act as a Land-use Planning Law

The Federal Endangered Species Act (ESA) (1973) is one of the most popular acts ever passed by Congress, in part because it helps protect symbols of American wildness such as bald eagles and grizzly bears. Since its enactment in 1973, the ESA, through judicial decisions, has become one of the most influential resource management and land-use laws in the country. A fundamental tenet of the law implies that any isolated population of a species can be proposed for listing under the Act. Consequently, California, with its diverse habitats and biogeographic history, has thousands of such populations distributed across the state that could be considered for listing. For more information on the ESA, see the U.S. Fish and Wildlife Service's Endangered Species Act Web site, http://endangered.fws.gov/esa.html.

Our state also has its own California Endangered Species Act (CESA), which applies to all native species of fish, amphibians, reptiles, birds, mammals, invertebrates, and plants, as well as their habitats. A description of provisions of CESA can be found by at the California Environmental Resources Evaluation System (CERES) Environmental Law, Regulation, and Policy Web site, http://ceres.ca.gov/topic/env_law/cesa/summary.html.

Currently, oak woodlands are not considered the primary habitat of any federally listed endangered species in California. Nevertheless, oaks occur as a habitat component of an exceptionally large number of vegetation types in California, including most types that are considered primary habitat for federally listed endangered species (e.g., riparian woodland, coastal sage scrub, vernal pools, and serpentine soils). Though relatively few populations of oaks will ever be specifically protected under the ESA, other listed species found in oak habitats provide de facto consideration for the oaks when assessing critical habitat requirements.

Authority of the ESA

The Federal Endangered Species Act takes precedent over all local, state, and federal resource laws and practices, and all city and county planning and permits. Regardless of state or county permits, any action deemed as a "take" of an endangered species can be stopped by injunction or arrest. Section 9 of the ESA defines "taking" and outlines criminal acts.

Throughout the planning process, regardless of whether state statutes such as CEQA apply, a project that involves federally listed species may be required to undergo scrutiny under Section 9 of the ESA. In most cases, if terrestrial flora and fauna are provided ESA protection, the lead agency is the U.S. Fish and Wildlife Service. When considering aquatic species, particularly migratory fish, the responsible lead agency may also be the National Marine Fisheries Service.

Regional Plans and the ESA Single-Species Habitat Conservation Plans

In 1982, Section 10(a) of the ESA was amended to allow a "take" under prescribed situations. The amended section allowed projects to proceed if they voluntarily developed acceptable habitat conservation plans (HCPs) for the endangered species they impacted. In California, Section 10(a) languished until the late 1980s, when local officials were threatened with indictment for ignoring the ESA when granting discretionary permits. Habitat conservation plans also failed as vehicles of regulatory relief in areas where endangered species could be brought into the review process in series, in effect achieving ongoing delays or exactions against development plans. The strategy of seeking habitat protection for each newly listed endangered species was labeled as the "species of the month club" by land development companies.

Multiple-Species Habitat Conservation Plans (MSHCPs)

A solution that emerged in California was the development of the multiple-species 10(a) permits, or Multiple-Species Habitat Conservation Plans (MSHCPs). The idea came from proposed projects on San Bruno Mountain (San Mateo County) when all parties involved recognized the shortcomings of single-species plans and adopted a plan that covered more than just habitat for the species in question, the mission blue butterfly *(Plebejus icarioides missionensis)*. A key agreement in this plan covered a group of unlisted species, protecting the landowner from further exaction should these species be listed in the future. These habitat plans provided local, state, and federal agencies with a means of promoting comprehensive land-use planning, thus hopefully avoiding some of the piecemeal destruction of wildlands through suburban sprawl.

In 1991, the California Resources Agency developed a similar multispecies planning process called the Natural Community Conservation Planning Program (NCCP) to resolve similar conflicts associated with CESA. This vehicle provides the state with increased certainty for land development and regional conservation. The NCCP reestablished state control over endangered species planning, provided for interim "take" permits, reinvigorated prelisting agreements, and protected "unoccupied" habitats. From an optimistic perspective, these plans supported long-overdue wildland planning on a bioregional basis.

Mechanisms to Create Bioregional Plans and Preserves: Endangered Species versus Ecosystem Protection

The overriding intention of MSHCPs and NCCPs is to eliminate future conflicts over species listings by initially covering the maximum number of species. They invariably include species listed under the ESA but may also include other species that may eventually be listed. While this may be conceivable for well-known populations of vertebrates and vascular plants, it is clearly not possible for poorly understood species, including invertebrates (a group that is most likely to produce endangered species in the future). Local governments and land developers see large-scale protection of entire systems as the best choice for conflict resolution. Hence, defining the relative importance of long-term ecosystem management versus single-species protection is a major task for most plans.

Identifying Preserves: What Criteria Matter?

Models that simultaneously resolve the habitat needs for multiple species are currently not available. However, three basic systems have emerged as guiding principles to help planners select preserve areas, though only two have been applied in conservation strategies. They include simple scoring and ranking or iterative processes.

Simple scoring models

Simple scoring models represent the most widely used type of selection process in current California planning. Scoring processes rank potential preserve areas by a defined set of criteria; these rankings indicate which areas should receive the greatest protection or priority for acquisition. In many cases, scoring systems identify only thresholds or broad classes of sensitive areas and lack individual rankings. Because scoring systems do not necessarily assume any specific action, they are less concerned with selection efficiency and are the most simplistic. Most MSHCPs in Southern California have used scoring systems to identify priority areas (see chapter 7). Typical scoring criteria might include

- oak habitats most at risk of imminent conversion
- acres of contiguous habitat
- presence or absence of unique habitat elements such as vernal pools, riparian areas, and valley oak woodlands
- historic values

Iterative processes

Most planners use iterative processes to evaluate future steps in conservation planning. Iterative methods are concerned with the efficiency of each step taken to build a preserve system. At a minimum, they stress complementarities, expressed as the number of new items that a preserve unit could add to the system when considered against units already chosen. Iterative processes can be inefficient because redundant units remain in the preserve system; however, the unit-by-unit selection most closely replicates the actual process of acquiring preserve areas in most MSHCPs. Typical criteria used in an iterative system include

- adjacency or juxtaposition of acres of contiguous habitat and connective opportunities to create corridors
- comparison of the cost of protecting a unit relative to the cost of the foregone biodiversity of the unit, in addition to an iterative complementary analysis

Criteria for assessing attributes

All preserve selection approaches are susceptible to inefficiencies when initial tenets fail to match existing landscape conditions and threats. Specifically, a planner must be aware that either system can potentially select more land than is necessary or ignore problems that may be impossible to correct in subsequent management. Two criteria that may be useful to assess landscape attributes that are applicable to fragmented habitats are

- flexibility, or the ability of an area to produce a number of alternative preserve configurations that meet specific conservation strategies
- irreplaceability, or the number of times a planning unit was included as a component part of different alternative configurations

Estimates of flexibility and irreplaceability in a study area can help focus discussions among interest groups on the importance of a specific unit or a design alternative. When the goals of a preserve system are unclear, estimates of irreplaceability can provide a feedback mechanism for setting levels of resource protection. A geographic information system becomes invaluable for quick modeling of preserve alternatives and subsequent identification of irreplaceable areas (see chapter 7).

One of the strongest attributes influencing reserve selection systems is the degree

to which uncommon species are contained in distributions of more common species. Studies have shown that a sequential loss of species is linked to an increase in habitat disturbance or decrease in habitat area, yielding a conventional wisdom that rare species typically are coincidental with areas of species richness. However, work focused in Southern California pointed out that rare plants are not nested within the occurrence of other plant species; therefore, a preserve system based solely on maximizing the number of plant species will be relatively inefficient in protecting rare plant species. The occurrence of narrow endemics in areas of low species richness appears to be a general pattern in most Mediterranean ecosystems and is arguably the case for many California endemics.

Developing Units for Comparisons

The landscape units chosen in a regional conservation design can have a profound effect on the effectiveness of a reserve. An obvious example of how a landscape unit can bias reserve effectiveness can be seen in the difference between watersheds and ridges as sample units. Watershed-based units can clearly define differences in habitat for salmonids but may fail in evaluations of habitat for cross-watershed migrations of deer. In contrast, ridge-based units may clearly discriminate migration corridors for deer, but muddle the evaluation of salmonid habitat by splitting streams and hydrologic units. Choosing either type of unit promotes the management of one species over another. With literally hundreds of candidate species, the careful selection of sample units and the definition of their constraints are two of the most important steps in regional planning.

Most examples in the scientific literature, by default, use some type of ecologically defined unit, with boundaries drawn between units with differences in assigned properties. Vegetation forms the basis for most of these units, which are often created through remote sensing techniques. In some cases the units are self-defining, such as habitat fragments and islands or specified habitat types regardless of the surrounding matrix. Hydrologic units are also self-defining, although decisions must be made over subdivisions among drainages.

Because regional plans usually occur on lands divided by ownership, the most functional selection units from the land-planning perspective are land parcels divided by ownership boundaries. This kind of unit has been used in Australia. However, ownership-based units have been rejected for preserve selection in Southern California because the selection process may affect the sales value of parcels and disrupt the creation of preserves. That is, parcel-based analyses alert landowners to the monopolistic values of their properties in reserve designs, increasing their value. In regions with highly subdivided wildlands (5- to 10-acre [2- to 4-ha] lots), the number of potential litigants makes parcel disclosures a legitimate concern.

Any system of geographic units has varying degrees of efficiency across an area. A system that clearly discriminates preserve values in one geographic area may be inefficient in other areas because of different characteristics or gradients of characteristics. The complexity of identifying proper units in developing reserve strategies demonstrates the need to compare multiple sources of information, including species accounts and distribution information, in combination with existing technologies such as geographic information systems to better understand spatial considerations.

Geographic information systems (GIS), which can rapidly combine and manipulate many layers of spatial information, have created a new platform for multiple-species preserve planning. Unfortunately, these systems can also be used to create simplistic generalizations that appear to be precise map products. In the absence of time and data, the clear danger is that an MSHCP study area can become obfuscated, rather than illustrated, by these maps.

The Role of Planners and Scientists in Reserve Selection and Design

Multiple-species planning has created an opportunity for a long-overdue partnership between land-use planners and conservation biologists. Science advisors should work with planners to separate questions that can be answered by research-based information from questions that can be answered only by policy decisions. The potential for "stealth" policy is exacerbated by value-laden questions such as "Which preserve is best?" Scientists should help planners and decision makers rephrase these questions into a more tractable format, such as, "Which preserve has the greatest probability of protecting the species under review?" Other opportunities for scientist–planner interactions include

- mapping exercises in which all threats to and needs for resource persistence are indirectly accounted for by size, shape, proximity, and linkages of preserve polygons
- discussions on the persistence and disruption of internal processes in reserved areas, such as rates of extinction and extirpation, genetic impoverishment, alteration of species interactions, and disruption of fire cycles or hydrologic processes
- discussions of external threats such as invasions of exotic species or flows of pollution onto reserves

It should be noted that internal and external problems are not mutually exclusive; the division is an artifact of reserve boundaries, which arbitrarily define which issues will be managed in the preserve and which issues have to be treated as external factors.

The greatest benefits of scientist–planner collaboration may come from their ability to identify the limits of science-based knowledge. Reserve decisions should be supported by research-based information; however, policy makers must often decide issues that cannot be solved by research-based information.

As an example, in western Riverside County, a science advisory committee identified 5 intrinsic, 4 trans-boundary, and 4 human-caused conditions in their MSHCP study area. Each condition led to a management hypothesis, dependent on the level of information available for each situation. Unfortunately, the potential for interference among the management actions became apparent once individual species needs were analyzed. For example, the conversion of non-native grassland to coastal sage scrub may increase sage-scrub species but could conflict with the protection of sensitive grassland species such as the grasshopper sparrow, thereby resulting in a less than desirable condition.

The solution to conflicts such as this is probably pragmatic; that is, policy makers should use delineation of threats or mapping exercises only as long as they contribute to functional decisions. As specific information on each reserve increases, MSHCP participants should be ready to discard, amend, alter, or replace generalized statements and untrue hypotheses. The effective MSHCP should be inductive to the point of blending the disparate needs of hundreds of organisms, but deductive enough to produce manageable reserves.

To summarize, the most common situations in MSHCP reserve selection and design have been:

- Preserves have been the products of political compromise refined by, but not driven by, science.
- Plans use the best available science, but little knowledge exists on the majority of management questions facing MSHCP processes.
- Management plans become the only means of correcting problems created by inadequate preserve configurations.
- Plans are developed that do not address conflicting sets of aesthetic and amenity values, which are unimportant in intact systems but will create management conflicts as the reserves are challenged by adjacent land development.

Operational hypotheses derived from past MSHCP processes are:

- Reserves should be defined by the threats to their biological resources as much as they are defined by resource values.
- It is easier to maintain functional systems in a preserve than to attempt to recreate or maintain systems using postfacto management corrections.
- The persistence of reserve states and processes depends on the capacity of a reserve to correct for predictable, unpredictable, and unknowable problems.

Science versus Politics

Critics of the HCP, MSHCP, and NCCP processes have not been convinced of the merits of scientific advice and have often demanded scientific oversight. Some have argued that HCPs tend to stray from (or simply ignore) scientific advice when it conflicts with other goals of project proponents. Many interest groups have a straightforward interest in maximizing coverage for "taking" and minimizing compensation in process negotiations. A legitimate fear of environmentalists has been that their political leverage will be insufficient to thwart marginal plans that could use unsubstantiated designs to grant land development with limited certainty for species and habitat persistence. Conservationists and scientists have called for formal review to insure that MSHCP strategies were technically sound. Others have countered with the idea that the issue of scientific "peer" review of completed plans is often promoted as a red herring to hide less-noble antidevelopment sentiments. This statement seems to confuse the need for review of the science used in an MSHCP with the demand for more oversight of MSHCP policy. State and federal agencies have been concerned that scientific reviewers will attempt to examine the merits of policy and regulatory decisions, challenging the fundamental responsibility of regulatory agencies. However, if reviewers focus on the conservation science in MSHCPs, they can improve the quality of the plans and the information passed on to decision makers.

The most compelling argument for peer review comes from environmental impact assessments. The science used to develop environmental assessments has rarely been subjected to peer review, either in the scoping phase of study or in final reports. Environmental documents rarely lead to published articles in refereed journals and have yielded less advancement in environmental assessment than their expenditure of effort would predict. The science used in environmental documents from the 1990s is often remarkably similar to the science in reports used the 1970s, despite the advances in conservation science. When the MSHCP process as proposed in the late 1980s, the professional group capable of regional planning had created a culture of ecological studies based on unsubstantiated statements and untested mitigations.

Chapter 6

Planning Options for Oak Conservation

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Planning and Oaks

Since 1973 commercial, industrial, and intensive agricultural development has been the greatest cause of oak woodland loss. Over the past 30-plus years cities and counties have developed and implemented a wide variety of planning vehicles (general plan language, ordinances, discretionary permits, ad hoc committees, incentive programs, and educational programs) intended to promote conservation of oak resources. Additionally, the legislature and the courts have handed down a number of decisions that have impacted local, regional, and state planning efforts. This chapter provides ideas, examples, and scenarios that may be applicable for the conservation of oak resources through the established planning process.

The general plan still offers a planner ample opportunities to address oak conservation in at least three of the required seven elements: land use, conservation, and open space. The challenge, as with all planning, is to ensure consistency throughout the general plan. For example, if oak trees are identified as an important resource worth protecting, the circulation element should address how to minimize disturbance to oaks from road layout and maintenance. Maintaining this type of uniformity is important to minimize confusion among people involved in various projects. Crafting a general plan is more easily said than done and can often be an expensive, messy, and frustrating process.

Within the greater context of the planning process, counties and cities have had both the pleasure and annoyance of facing a number of alternative forms of planning that affect oak woodlands. Recent examples include public purchase of open space, ballot initiatives that may arbitrarily identify planning requirements, tree ordinances spawned as the result of a "crisis," the establishment and expansion of land trusts and conservancies (resulting in more private dedications), and easements providing a dual benefit of conserving oaks while increasing public awareness about the resource. Planning tools such as transfer of development rights (TDRs), cluster zoning, and mitigation banking have all been used to minimize the intrusion or impacts of development in oak woodlands.

Planning Principles for Oak Conservation

The goal of conserving oak resources should be to achieve a long-term, sustainable oak woodland resource. The well-being of oak woodlands as an ecological unit, rather than that of individual trees, must be at the forefront of the discussion. No matter how large or imposing a single mature oak tree may be, it is the long-term propagation and growth of young oak trees that ensure the survival of oak woodlands and the associated floral and faunal communities. Planners must also appreciate the value placed on individual trees by local residents. Though these individual "heritage trees" may not be critical for maintaining viable wildlife populations, they can often heighten community awareness regarding oak values, and they can be useful in generating community and political support for other oak-related projects.

Oak woodland conservation strategies may require a longer time frame than standard planning strategies. Oak woodland management issues don't always fit into local planning schedules, such as 10-year general plan updates, since an oak seedling requires decades to become a major ecological player. On the other hand, local planning issues may heat up overnight as the result of some widely publicized event, such as cutting trees at a highly visible location. Long-term perspectives identified in the appropriate element of the general plan may help the community withstand short-term turmoil following an incident such as the illegal cutting of a highly valued tree. Monitoring and updating information, though often expensive and difficult, are critical to determining if management changes are needed.

Community support and involvement have proven essential in resolving natural resource issues. Appropriate commodity groups, established watershed groups, and other credible community organizations should be contacted and brought into the decision-making process. Though they may at times be parochial in their views, these groups can often provide a broad range of expertise, energy, and interest to a local issue. Channeling that energy in the right direction can be a useful approach to finding planning solutions among various landowners.

It has become apparent over the past few years that state and federal agencies have broad jurisdictional powers over resource issues that may involve oak woodland planning, such as water quality or threatened and endangered species. These same agencies can also provide important technical guidance or assistance that might otherwise be lacking in some rural locations. A working list of resource professionals in a given geographic area could be an important tool for anyone who is developing an oak woodland management plan or is involved in reviewing projects that could potentially impact oaks.

The Planning Process: Four Steps for Oak Conservation Planning

Planning is a highly political process that often involves a number of stakeholders. Typically, natural resource planning plays a central role in local development issues and often results in highly emotional and polarized debates. Inherent conflicts can emerge between local municipalities who may focus on resource management from an economic point of view, rather than from the view of protecting natural systems for their own sake. The latter position is often the position taken by state and federal resource agencies. Additionally, most oak-related planning issues are multidisciplinary, with engineering, biological, and social perspectives. Conflicts are inevitable and must be addressed directly. Paramount to the successful execution of a planning process is the need to establish a common language between the various groups involved if the discussion is to be fruitful.

The following questions can help develop oak conservation planning strategies that address the biological and social aspects of planning. They can be applied to any planning effort, including general plan updates, county or city woodland conservation programs, and woodland conservation mitigations for a single project.

1. What Do You Have?

An assessment of oak resources provides the foundation necessary for developing a management strategy. A number of details can be included in an assessment. The assessment can include biological, financial, or social information, or a combination of all three. The primary goal of any assessment should be to establish a baseline against which change can be measured over time. Oak resource assessments have relied on various approaches, including efforts by ad hoc committees, standing committees, available field inventories (ground surveys, aerial photography), educational programs, or some combination of these. In many cases, much of the information gathered as part of the assessment already exists and simply needs to be coalesced into an accessible format.

Here is a sample checklist to use when developing a comprehensive assessment of oak resources and related projects and programs that may exist in a given area.

Assessment of current status of oak woodlands:

- species occurrence and distribution
- ownership patterns
- land-use patterns
- biological and physical aspects of the woodlands in a region

Assessment of programs and activities focusing on oak woodland conservation:

- land trusts operating in the region
- ongoing educational programs
- special district activities that may impact oaks
- private land management initiatives active in the area
- other efforts aimed at oak woodland conservation

Assessment of oak resources at risk:

- activities causing net loss of oak woodlands
- activities causing fragmentation of functional habitats
- impacts to family farming operations
- impacts of increased regulatory oversight
- activities affecting land values

The extent and characteristics of any assessment should reflect the scale of the planning effort. It may be necessary to assess associated habitats of biological significance to ensure that the proposed project does not indirectly impact their integrity. For instance, riverine habitats, contiguous acres of oak woodlands, heritage tree locations, vernal pools, or areas of social importance such as parks, greenbelts, or planting programs may have to be identified. Generic maps of distribution and acreage of oak species may be adequate for general plan policy development, but the selection of specific open space areas, preserves, parks, or mitigation sites requires more-detailed data to reflect site characteristics such as acreage, tree density, age structure, species diversity, and understory vegetation.

The current condition of oak resources is the result of several factors, including present and past management practices such as grazing, fire suppression, and clearing of land for various land uses, as well as natural processes. Any assessment of current conditions should include an overview of existing uses, regulatory constraints, available voluntary programs, and activities that threaten oak woodland sustainability. Once gathered, this information can then be made available to constituents interested in oak-related issues.

2. What Do You Want?

Though planners do not have complete control over the outcome of any particular process or project, they do have the ability to influence local thinking. Planners equipped with information from resource assessments can help influence the discussion regarding resource goals and objectives by choosing the appropriate planning vehicle. If the intention is to develop a strategic plan to conserve oaks, it may be necessary to outline a separate outreach strategy to ensure that all stakeholders have access to the same set of information. Simply compiling an assessment and placing it on the Web may not be sufficient to gain broad acceptance of the materials. It may be equally important to convene an educational forum to create a wide-ranging discussion of the information in an atmosphere of understanding by all participants. Conservation strategies must consider biological criteria such as regeneration, habitat size and continuity, understory vegetation management, watercourse protection, and social interests such as aesthetics and public participation to be effective.

Inviting public participation early in the process can assist in developing goals and objectives prior to positions becoming intractable. If it is not feasible to immediately address all of the needs identified, planners must prioritize goals, distinguishing between those that can be achieved quickly and those that may require longer time frames.

Public participation in the goal-setting process also serves an educational function, providing an opportunity for citizens to learn about the interdisciplinary nature of planning. In today's complicated public policy environment, confusion over existing laws and policies often leads to tension among participants. Some important laws that affect planning that might be useful to explain include

- the California Environmental Quality Act (CEQA)
- state and federal Endangered Species Acts and their role in protecting flora and fauna on private lands
- the federal Clean Water Act (CWA) that can indirectly affect land-use patterns and practices
- the state streambed alteration permit that must be obtained from the California Department of Fish and Game by private and public landowners before they alter the natural flow of any river, stream, or lake
- the state Forest Practice Act (FPA) that may impact the harvest of oaks under certain conditions

Effective oak management strategies may also need to be coordinated with other existing resource-oriented programs such as

- wildland fire protection policies included in the general plan or existing wildland fire regulations
- farmland preservation policies associated with the state's Williamson Act program
- timberland production zoning (TPZ) or other special zoning that may affect management activities in areas forested with oaks
- local requirements, ordinances, or restrictions

Setting oak conservation goals. Goals are the tangible ends that the management strategy seeks to achieve. It is important to set goals that are quantifiable in some way, so that progress toward the goals can be measured. Some specific goals for oak woodland management might include the following:

- achieving no net loss of oak woodland habitat in a prescribed time frame
- restoring and restocking degraded oak stands
- increasing oak woodland habitat extent and quality on private and public lands
- centralizing and coordinating oak woodland management activities
- promoting oak woodland conservation and enhancement on private lands
- restricting fragmentation of oak woodland habitat
- avoiding or strictly mitigating development near sensitive or significant oak woodlands

3. How Do You Get What You Want?

An oak resource strategy should focus on conserving the resource, not on conducting a bureaucratic process. When developing a strategy a number of planning mechanisms can be applied in order to achieve any specific goal. Feasibility, practicality, legality, and economics must be considered when selecting the appropriate planning and management tools. For some goals, several management options may be necessary, such as combining open space easements with farmland protection policies to enhance oak woodlands throughout a county. Other instances may require the use of a specific tool, such as the application of CEQA in order to evaluate the cumulative impacts resulting from the net loss of oak woodland acreage from a specific project. The methods used to attain various goals should also be integrated into a functional action plan.

At the time of the previous edition of this book, conventional wisdom suggested that replanting oak seedlings was a viable means of insuring oak sustainability. With time come new ideas and an evolution of thought, and most ecologists now recognize that replacing a century-old tree with 1, 3, or 10 one-year-old seedlings does not adequately replace the lost habitat values of large trees. It has become evident that simply focusing on mitigation plantings based on a tree to seedling ratio is not a sufficient strategy to ensure the viability of oak woodlands. Although recruitment of young cohorts is still an important consideration, there is broad recognition that it is critical to conserve the inherent values that exist in mature oak forests wherever possible. In order to achieve such a lofty goal it is important to recognize the many types of conservation strategies that are available to both the private and public sector. They include

- outright public purchase
- tax incentives

- trade agreements
- conservation easements
- performance zoning
- real estate transfer tax
- transferable development rights (TDRs)
- voluntary registry programs
- public agency programs

Citizen involvement and support continues to be critical in this phase of the process. Management approaches and tools that are unacceptable to city or county residents are unlikely to succeed. If a local government intends to push for more progressive oak management, it should choose tools that will build citizen awareness and support, including educational and incentive programs.

Although a conservation strategy or management plan may appear ideal on paper, it clearly cannot achieve anything unless implemented. A review of alternatives may be time-consuming and use valuable staff time, but the knowledge gained from an early review of alternatives can save considerable time and effort later on in the planning process. It is also a useful way to bring about a compromise concerning issues in the community.

4. Are You Getting What You Want?

For any plan, program, or project, a time and action schedule should show the sequence of steps that are involved and the time within which they should be completed. Keep the management program at a high profile to maintain public interest and local government commitment. Progress reports to the county board of supervisors or the city council may help keep public attention on the program. These reports can be in the form of written reports, field trips, educational forums, educational displays in public places, or other graphic displays.

Oak resources and management practices should be evaluated on a regularly-agreed-upon schedule to determine if goals are being met. If monitoring shows a lack of progress toward goals or a deterioration of the oak resource, a change in the management plan may be required. In turn, these changes must be monitored and evaluated. These feedback steps allow the planning process to cycle repeatedly so that the management plan can evolve to keep pace with changes in the oak resource. A monitoring component ensures proper feedback on policy actions, creating a situation where objectives are refined and tailored to specific conditions.

A comprehensive oak woodland management strategy should include monitoring of protected trees. It should also include short-term maintenance to help planted trees establish and should also provide for a long-term program strategy evaluation. Interactive approaches that may support monitoring may include

- establishing covenants, codes, and restrictions (CC&Rs)
- providing for management and communication through homeowner associations, commodity groups, etc.
- providing educational literature to homeowners
- developing brush control or controlled burning plans with local and state fire agencies
- establishing leasing arrangements with livestock operators

The difference between monitoring and reporting

Planners have to choose whether to monitor mitigation, report on mitigation, or both. The two concepts are often confusing, and the program best suited to ensuring compliance in any given project will usually involve some combination of both elements (see CEQA Guidelines § 15097).

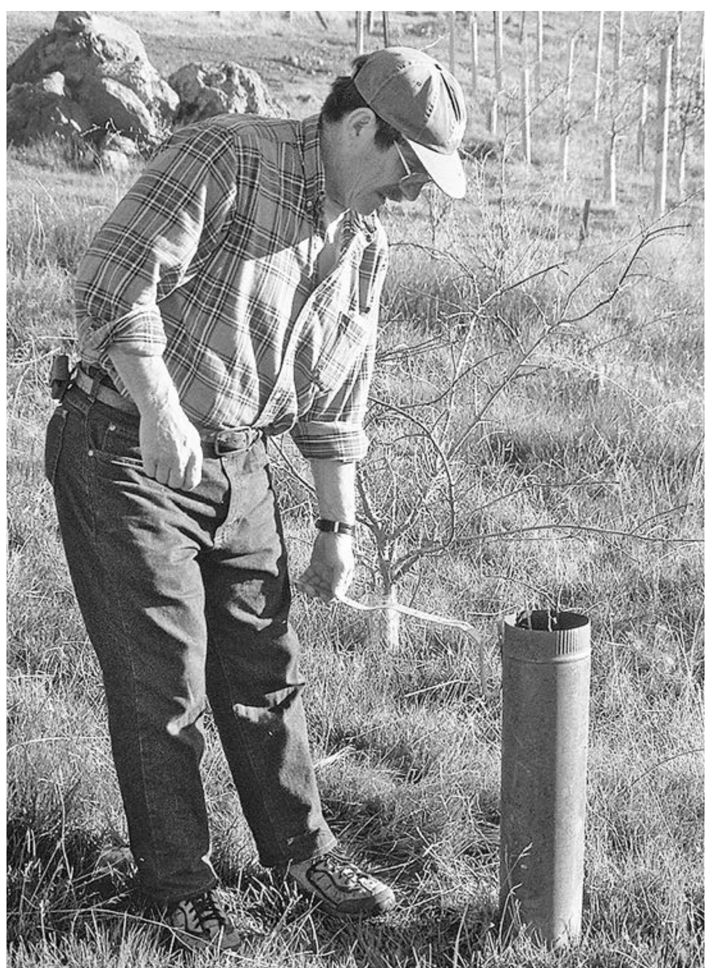
- **Monitoring**. Monitoring is generally an ongoing process of project oversight and is best suited for projects requiring complex mitigation that may exceed the expertise of the local agency. It is expected to be implemented over time and may require careful implementation to assure compliance.
- **Reporting**. Reporting generally consists of a written compliance review presented to a designated agency or individual. A report may be required at specified stages of a project. Reporting is best suited to projects that have measurable or quantitative mitigation measures.

Using the General Plan to Conserve Oaks

Planning has been described as "guiding the physical development of California's communities" (Fulton 1999). The general plan has two sets of implementing regulations: the zoning ordinance and the subdivision regulations. Both are useful tools to help guide conservation efforts, especially when used together. If the general plan contains conservation goals, the zoning ordinance (referred to as the Map Act) can help address specific objectives and policies that are consistent with protecting the intrinsic environmental values of natural resources. As previously stated, the land use, conservation, and open space elements provide the logical place for inclusion of language pertinent to oak resource conservation.

Standard Practices and Policies

As most planners realize, language alone may not suffice to achieve the desired outcomes stated in the general plan. Many ecologists believe that since most private lands fall within the jurisdiction of the county, in order to protect the integrity of the wildlands, there must be a set of standardized practices and policies incorporated in the general plan. It is also critical that the effectiveness of these practices and policies be evaluated over time. A standardized approach can provide the project applicants (and the public) with some assurances of what might be expected. This is not to say that mitigation would follow "cookbook" prescriptions, but rather that project evaluation should help establish a methodology for determining cumulative impacts to the oak woodlands over time. An example of using standardized language might include choosing a single source for use in habitat descriptions to ensure that all parties understand the semantics of a project. For instance, the California Wildlife Habitat Relationships (CWHR) system employed by the California Department of Fish and Game could consistently be used to predict wildlife impacts. Other suggestions to help standardize project evaluations include developing an inventory or master list of biological inventories, establishing an



accounting system, and including a plant community and wildlife habitat element in the plan.

A compilation of biological inventories might include maps, photos, site references, and biological accounts or histories of unique habitat types found in the county. An inventory system would enhance the decision-making process regarding impacts, and the standardized language could be shared with adjoining counties to help facilitate geographic examination of the resource. Inventory components might include

- common habitats
- target habitats (those provided special status)
- target use areas (areas afforded conditional use constraints)
- rare plant communities
- common plant communities

An accounting system to effectively track projects over time per habitat type provides the ability to monitor the net loss or gain of a particular habitat over time. Furthermore, it could facilitate data sharing and management efforts between various resource agencies, expediting the development and mitigation process. The components of such an inventory system might include a

- listing of approved projects
- listing of denied projects
- determination of project impacts (e.g., acres lost)
- listing of mitigation measures

A plant community and wildlife habitat element in the general plan can serve as a complimentary component to the existing conservation element. This element could include language aimed at achieving

- conservation of large contiguous tracts of habitat for plants, migratory fish, large mammals, and raptors, providing county-based, special-status considerations for species
- conservation of rare habitats or plant communities, including wetlands, vernal pools, riparian areas, native grasslands, etc.

The plant community and wildlife habitat element could also determine and specify allowable land uses, conditional land uses, and land development policies for each type of area. Projects would then be evaluated on a case-by-case basis. Potentially available sources of information for developing this element could come from

- archived county files
- natural diversity databases
- the California Native Plant Society
- public input

Including a plant community and wildlife habitat element in the general plan would also facilitate the development of wildlife and plant communities reference files for target species and their habitats, including information regarding biology, management, and planning over time. Furthermore, it could facilitate the examination of general plan build-out scenarios to help identify necessary zoning and mitigation measures that should be considered to minimize project development impacts to resources targeted for conservation.

Parcelization of Lands

A fundamental issue affecting oak conservation in many communities is the decision that affects subdivision or splitting of parcels. Once a large parcel has been subdivided, the small parcels subject the woodlands to a myriad of pressures, including an increase in human activities (buildings, roads, sewers, etc.), the introduction of feral animals and exotic plants, and increased forest edge that aids many opportunistic and predatory species. A county that wishes to protect oak woodland ecosystems must address subdividing and splitting of contiguous woodlands and develop habitat conservation plans that ultimately become part of the open space element in the general plan. This approach allows a county to evaluate its current resources, directing further subdivisions into areas of lower habitat values. It also gives them the opportunity to target CEQA mitigation on areas that have been designated and protected as high-value conservation areas in the plan.

Examples from the general plans of several California counties of specific general plan language that addresses oaks and oak woodland fragmentation include

- site development standards required for all discretionary and ministerial projects to minimize oak disturbance (Nevada)
- canopy coverage standards for oak woodlands applicable to discretionary permit review (El Dorado)
- project review for oak preservation (Kings)
- land use designation to address specific oak woodlands (Sacramento)
- use of environmental impact report process to analyze potential adverse impacts to oak woodlands (San Diego)
- regulations for oak protection through environmental assessment of project impacts (San Joaquin)
- impact assessment guidelines for oak woodlands (Santa Barbara)
- requirement for oak woodlands management plan for discretionary projects that will potentially impact oaks (Stanislaus)
- requirement for no net loss of valley oak woodlands for projects subject to CEQA (Tuolumne)

The conservation element is the section of a general plan that deals with flood control, water and air quality, and conservation of natural resources, including agriculture and endangered species. A broad range of management strategies can be set up to blend the specific needs of landowners with the public demand for conservation. Where reactive strategies are restricted to permit processes, proactive strategies can set up a broad range of management strategies, mandate buffer zones and wildlife corridors, and blend economic and aesthetic requirements. For example:

- Santa Cruz County has a sensitive habitat protection ordinance to determine land uses and specify performance standards for land in, and adjacent to, sensitive habitats.
- San Diego County has a habitat conservation plan and land dedication policies.
- Santa Clara County has a zoning ordinance for hillside and ranchland areas stipulating that no more than 10 percent of healthy mature trees may be cut on a given property in a year.

The land-use element of a general plan can be used to create patterns of housing, agriculture, and woodlands; designate housing concentrations; and minimize woodland conversion. By limiting parcel size and providing for clustered housing, the land-use element can protect amenity values, guide development toward less-sensitive habitat areas, and minimize fragmentation of oak woodland habitat. Examples of land-use elements from counties throughout the state include the following:

- Tree preservation and replacement plans are required for discretionary permits on high-density projects (El Dorado).
- Project reviews are required to help prevent land use and planning decisions from adversely impacting woodlands (Yuba).
- Cluster development policies are encouraged to facilitate protection of woodlands (Sacramento).
- Project design standards are established for woodlands and individual native trees (Santa Barbara).

The open space element is the part of a general plan most widely used to maintain natural resources. Under this element, a percentage of undeveloped lands are set aside for open space. This strategy tends to be more successful for larger plots of land, where room for buffers is available and where the population density may be relatively less. Open space easements often allow minor construction of pipelines, flood control structures, and high-use recreation areas that may not be compatible with resource management guidelines. Although it is possible to allow multiple uses of oak woodlands, considerable care and management is needed.

As a reference, the Governor's Office of Planning and Research (GOPR) General Plan Guidelines provide ideas for consideration in the open space element. They suggest

- identifying woodlands by species, with density of 5 or more trees per acre (12 or more per ha) of blue, valley, Engelmann, or coast live oaks as being relatively important
- assessing, as a ranking criteria for open space consideration, woodland declines due to past and present management and land-use practices to help determine trends that may ultimately place woodlands at risk

Using the general plan in combination with other zoning laws, a planner can identify a suite of suitable alternatives, including conservation easements, cluster zoning, development rights transfer, restrictive covenants, ordinances, mitigation banking, and participation in the Williamson Act. These alternatives are designed to protect oak woodland resources while not unduly impacting conservation-minded landowners.

CEQA and Oaks

The influence of the California Environmental Quality Act (CEQA), though not specifically considered a "planning law," has increased dramatically since the previous edition of this guide. CEQA has evolved and expanded through litigation and development of local and statewide programs (e.g., SB 1334 Kuehl (2004), California Fish and Game 1600 Stream Alteration permits, county ordinances requiring discretionary permits) to become a formidable force in planning. Often referred to as the "public disclosure law," CEQA, with its inherent review process, potential mitigation measures, and its ability to provide transparency through the public hearing process, is both reviled and acclaimed by local advocates of planning and conservation. Though commonly considered an act that has significantly increased environmental-related planning actions, statistics show that only 1 in 20 CEQA actions lead to an environmental impact report (EIR), and only 1 in 350 CEQA actions result in a lawsuit (Fulton 1999).

Though often accused of resulting in a "taking" of land, the courts have ruled that CEQA's primary role is to identify potential impacts on the environment and to develop appropriate mitigation measures to minimize those impacts. To that end, CEQA's four specific functions include:

- Inform decision makers about significant environmental effects.
- Identify ways environmental damage can be avoided.
- Prevent avoidable environmental damage.
- Disclose to the public why a project is approved even though the project leads to environmental damage.

Unique to the CEQA process is the ability to treat each property and project individually, whereas traditional zoning and planning schemes treat all properties similarly. This peculiarity has been praised as an advantage and chided as a shortcoming of the law. The traditional tools historically associated with CEQA—EIRs and negative declarations—are still viable.

However, many counties have developed innovative approaches beyond the traditional EIR-negative declaration process to include public participation and discussion to assist in the planning process while still achieving CEQA's primary goals. For instance, Lake and Santa Barbara Counties have initiated extensive public participation into their CEQA review process. Though at times lengthy, they have proven successful in addressing many issues that would have otherwise not been addressed through the traditional approach.

Project Evaluations

Impact Identification

Planners recognize that many of their jobs are to provide a "yes" or "no" answer to project proponents. In most cases, the decision is based on existing rules such as zoning or a particular ordinance adopted by a municipality. However, as more projects are now subject to discretionary approval, both planning commissions and the public have a greater opportunity for input, potentially affecting the final outcome of a project.

The concept of discretionary review is based on the conditional use permit process, which gives planning commissions the opportunity to review individual cases even when the "use" is permitted under the existing zoning ordinance. The expanded application of discretionary review demonstrates the growing influence of CEQA to encourage public debate on the environmental aspects of a project.

Developing a list of criteria based on the directions found in CEQA guidelines can be a useful tool for determining project impacts on oak woodlands while insuring that a project will be administered equitably, objectively, and fairly.

Categories of Impacts Recognized in CEQA

Direct impacts

Direct impacts are the direct result of actions by the project applicant. Destruction or damage to trees and oak habitat resources caused by construction or other types of physical site disturbances are direct impacts.

Indirect impacts

Indirect impacts result from activities or effects associated with the project but are not directly caused by the project applicant. Disturbances to oak habitats that result from such things as increased access to the site, increased public use of the area, or changes to the quantity or quality of water on adjacent lands are examples of indirect impacts.

Short-term impacts

Short-term impacts generally last for only a short time and are usually followed by recovery of former site values. These impacts are often related to on-site disturbances that do not permanently alter the resource. A short-term impact might include temporary abandonment by a wildlife species caused by construction noises.

Long-term impacts

Long-term impacts last a long time or occur over time after project implementation. These may extend well beyond the mapped end of the actual activities approved by the plan or project permit. Therefore, when evaluating project impacts, planners should take into consideration the influence of the project beyond the time frame of project activities. An example of a long-term impact is a project that changes the normal flooding cycles of water flowing into a vernal pool or a project that protects vernal pool vegetation but eliminates upland habitat that is crucial for the survival of vernal pool plant pollinators.

Cumulative impacts

Cumulative impacts reflect the combined impact of effects from past, present, or reasonably anticipated future projects, including projects outside the control of the planning department or lead agency. Cumulative impacts must be adequately evaluated so that mitigation measures or sites are large enough, or situated properly, to compensate for extensive impacts.

Cumulative impacts are by far the most difficult aspect of a plan to evaluate. CEQA's inherent reliance on determining environmental impacts on a project-by-project basis makes determining cumulative impacts extremely difficult and has become one of the glaring shortcomings of the act. Planners must rely on external sources of information when trying to determine cumulative impacts. These sources may include historic photos, archived aerial photos, or past and present vegetation maps.

The California Department of Forestry and Fire Protection (CDF) has developed oak woodland maps (see the CDF Web site at http://frap.cdf.ca.gov/data) that may provide another source of information to determine cumulative impacts at a county or regional level.

Other CEQA Considerations

A number of categorical exemptions to CEQA have direct application to oak resource management. A full accounting of all categorical exemptions can be found in Article 19, §§ 15300 through 15329 of the CEQA Guidelines. Guidelines especially pertinent to oak conservation include the following:

- § 15300.2(b). **Cumulative Impact**. All exemptions for these classes are inapplicable when the cumulative impacts of successive projects of the same type in the same place over time are significant.
- § 15300.2(c). **Significant Effect.** A categorical exemption shall not be used for an activity where there is a reasonable possibility that the activity will have a significant effect on the environment.

In addition, Public Resources Code § 21084 provides several exceptions to the use of categorical exceptions. Pursuant to that statute, a project that may result in damage to scenic resources, including but not limited to trees within the right-of-way of a scenic highway may not qualify as a categorical exception (see *McQueen v. Mid-Peninsula Regional Open Space* (1988) 202 Cal.App.3d 1136).

Other guidelines that may be pertinent to reviewing impacts to oaks can be found in Public Resources Code:

- § 15304, Minor Alterations to Land
- §§ 15307 and 15308, Actions by Regulatory Agencies for Protection of Natural Resources
- § 15313, Acquisition of Lands for Wildlife Conservation Purposes
- § 15316, Transfer of Ownership of Land in Order to Create Parks
- § 15317, Open Space Contracts or Easements
- § 15325, Transfers of Ownership of Interest in Land to Preserve Existing Natural Conditions and Historical Resources

Table 6.1 identifies the types of impacts that should be addressed through CEQA. Table 6.2 gives examples of site-specific and regional information that may be needed for evaluating real and potential impacts on oak woodlands.

Level of Significance

Definition

Significant effects on the environment are defined in the CEQA Guidelines § 15382 as "a substantial, or potentially substantial, adverse change in any of the physical conditions in the area affected by the project, including land, air, water, minerals, flora, fauna, ambient noise, and object of historic or aesthetic significance. An economic or social change by itself shall not be considered significant effect on the environment. A social or economic change related to a physical change may be considered in determining whether the physical change is significant."

Drafting thresholds

Developing thresholds is not simple. The first step should be to identify effects for which thresholds are to be drafted. These might be chosen from an initial study worksheet, or they may be based on the significant effects identified in appendix G of the CEQA Guidelines.

Thresholds may be qualitative or quantitative. Some effects, such as traffic or noise, lend themselves to numerical standards. Others, such as aesthetics or wildlife habitat, are difficult to quantify and must rely upon qualitative descriptions. In either case, thresholds should be based on legal standards, studies, surveys, reports, or other data that can identify the point at which a given environmental effect becomes significant.

By establishing thresholds, a jurisdiction effectively recognizes the environmental ethics that are consistent with accepted local values. A note of caution regarding the use of general plan policies: Remember that a threshold represents the point at which a project's potential environmental effects are considered significant. The focus of the threshold is on actual limits to significant environmental impacts. When general plan policies or standards do not actually limit the potential impacts of a project to a particular level, they are not effective measures of significance. Most jurisdictions allow for some flexibility in the application of thresholds to individual projects, and this is generally a good idea.

Table 6.1. Impacts that may be considered under CEQA

Impact	Activities generating impact
immediate removal or damage to oak trees	clearing, grading, construction, and landscaping
	clearing and replanting for agricultural uses
	clearing or thinning for livestock pasture
	replacement of native oaks with noxious plants
reduced regeneration of oaks	replacement of native understory with more-competitive plants
	landscape management to remove small "weedy" oaks
	grazing of oaks by livestock
	increased wildfires that result from fuel buildup on ungrazed or unmanaged public land
reduced quality of wildlife habitat	fragmentation or dissection of habitat corridors
	increased domestic pet predation on local wildlife
	poaching of game species from increased road access
	removal of snags (dead trees)
	removal of plant litter for landscaping and fire protection
	modification of watercourses and riparian vegetation
	alteration of vernal pools, springs, and other water sources
reduced local economic production	loss of pasture and forage for livestock
	fragmentation of rangelands, which increases cost of livestock management
	injury and loss of livestock from predation by dogs
	conflicts between developments and ranchers over agricultural practices
	loss of fuel sources through oak harvest prohibitions
damage to soil and watersheds	erosion from oak clearing on unstable slopes or soils
	erosion from development or agricultural operations on unstable soils
	sedimentation into riparian areas
	disturbance of springs and seeps from development

Determining significance

Determination of whether effects are significant on oak woodlands depends on the biological condition of the resource and the social expectations of the area. A challenge for planners remains finding a balance between environmental protection and respect for private property and an individual's right to use their land for some level of economic return. A component of that challenge is developing an equitable approach to resource protection that can be applied to a number of projects that may impact oak resources.

An available option in determining significance is described in the State of California Governor's Office of Planning and Research publication *Thresholds of Significance: Criteria for Defining Environmental Significance* (available online at the CERES Environmental Law Web site, http://ceres.ca.gov/topic/env_law/ceqa/more/tas/threshld.pdf). Though thresholds may be challenging to develop, they do provide the community an opportunity to discuss oak resource protection during times that are not subject to reactionary pressures brought on by an "oak crisis." This exercise could be incorporated into the assessment process discussed earlier and could be facilitated by a group or combination of groups willing to work together.

Enacting thresholds helps ensure that during preliminary analysis all projects are evaluated in an objective and consistent manner. The thresholds of significance for any given environmental effect are simply those levels at which the lead agency determines the project to be potentially significant and will require more investigative information before a final decision is made.

Thresholds of significance are not intended to be stand-alone environmental evaluative positions; rather they should reflect the agency's policies and strive for project evaluation equity. Thresholds should be viewed as simple analytical tools for judging significance during the early stages of project evaluation.

Ideally, a threshold of significance provides a clear differentiation of whether the project may result in a significant environmental impact. Furthermore, thresholds do not substitute for the agency's use of careful judgment in determining significance (CEQA Guidelines § 15064).

As an example, Lake County has established a threshold of significance as part of its grading ordinance. A project is subject to CEQA review only if 10,000 square feet (1/4 acre, or about 930 square meters) of native vegetation is proposed for removal. This standard is used for all proposed projects, regardless of whether they are commercial, industrial, or agricultural. Though not specific for oaks, it recognizes the varied nature of the county's hardwood forest and pertains to all native vegetation including oaks.

A threshold may be based on standards such as:

- ecological tolerance standards such as physical carrying capacity, impacts on declared threatened or endangered species, loss of prime farmland, or wetland encroachment
- cultural resource standards such as impacts to historic structures or archaeological resources

Standards relating to environmental quality issues are listed both in the Initial Study Checklist and appendix G of the CEQA Guidelines. Those criteria relating to oak woodlands can be found under Section IV, Biological Resources. They include the following suggested standards for evaluation:

- Would the project have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, or a sensitive or special status species in local or regional plans, policies, or regulations?

- Would the project have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, or regulations?
- Would the project have a substantial adverse effect on federally protected wetlands (including, but not limited to, vernal pools)?
- Would the project interfere substantially with the movement of any native resident or migratory fish or wildlife species, or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?
- Would there be conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?
- Would there be conflict with the provisions of an adopted habitat conservation plan or other approved plan?

Table 6.2. Site-specific and regional information that may be needed for evaluating real and potential impacts on oak woodlands

Information	Source
regional information	site-specific data
total woodland acreage	pre- and post-project woodland acreage at site
percentage and distribution of oak types and cover class (e.g., maps)	species composition and stand structure (distribution of small and large trees)
	canopy cover
regional success of oak regeneration	stand or site regeneration dynamics
	presence of saplings
	regeneration by seed or sprouting
regional wildlife resources	stand habitat values
ranges of threatened and endangered woodland species, both faunal and floristic components; unique habitats (i.e., vernal pools, streams, etc.)	threatened and endangered populations and habitat
	populations and habitat of special concern
distribution and amount of riparian woodlands	presence of streams, springs, ponds, pools, riparian vegetation, wetlands, etc.
regional recreational, tourism, and aesthetic resource areas	recreation sites, heritage trees, historic sites, viewsheds

It is vital that biological criteria be considered when considering significant impacts to oak woodlands from proposed activities. Clearly, any project that produces a net loss in habitat will have some level of impact on plant, fish, or wildlife populations. The challenge is to determine whether the impact is significant based on surrounding land-use practices, trends in development pressures, and the extent of the existing oak resource. The scientific literature is forthright in its assessment that the condition of California's landscape today has been shaped by a series of individual land-use practices that in aggregation have produced significant environmental ramifications. (Walter 1998). Therefore, it is important to consider the project in light of the surrounding environmental conditions in order to develop meaningful mitigations.

In some communities, the loss of aesthetic and historic values associated with individual trees may be considered significant under these guidelines. As a result, mitigation efforts (including considerable expense in some cases) may be directed at replacing or protecting individual trees or small stands of trees. The following questions may be useful in evaluating the significance of impacts to oak woodlands,

With respect to direct and indirect on-site impacts, will the project do the following:

- Affect tree density, tree canopy, tree health, and stand-age structure and understory vegetation?
- Affect wildlife habitat or the potential for oak regeneration?
- Eliminate trees with important biological characteristics (snags, obvious nest trees, etc.)?
- Disturb or eliminate archaeological or other historical values of the landscape?
- Increase access to the site?
- Change the habitat distribution patterns of the area (i.e., lead to habitat fragmentation)?

With respect to off-site impacts, will the project or proposed action do the following:

- Impact adjacent wildlife habitats?
- Impact a critical corridor for wildlife or plant species or community?
- Impact an existing critical buffer between development and woodlands?
- Reduce the quality of experience of adjacent recreational uses?
- Impact viewsheds?
- Result in a change in management that increases fire hazard in adjacent woodlands?
- Reduce the quality of adjacent agricultural resources?
- Result in conflicts between urban and agricultural neighbors over farm or ranch practices?
- Result in downstream or downslope sedimentation, erosion, or decreases in water quality that are detrimental to vegetation, wildlife, recreation, visual resources, or agricultural operations?

With respect to cumulative impacts, will the current project, in combination with past, present, and future projects or activities related to the proposed action, do the following:

- Impact oak woodlands affected by the project that are critical to the maintenance of botanical, wildlife, recreational, or viewshed values?
- Decrease biological diversity by eliminating oak habitats that are already limited in the region?
- Impact oak species of special significance (e.g., valley oaks that may have greater aesthetic and heritage tree values)?

- Impact oak stands with distinctive attributes (e.g., a site with good regeneration; a density class that is not present at many other sites; a stand with a high degree of biological diversity)?
- Increase fragmentation of oak woodlands?
- Reduce or isolate habitat corridors?
- Increase the development pressures that will alter or effectively eliminate remaining wildlife habitat values on the site?

If the answer to any of these questions is "yes," the impact may be significant.

When developing a checklist to determine the potential and real impacts of a project in oak woodlands, planners may wish to consider the following questions in determining whether a negative declaration or EIR is warranted. These questions can be viewed in the context of having direct, indirect, short-term, long-term, or cumulative impacts.

- Will the project increase or decrease the oak woodland resource base?
- Does the project remove or significantly alter key elements of fish and wildlife habitats (e.g., shade, nest cavities, water quality, vernal pools, etc.)?
- Does the project involve the extraction of wood resources, thereby affecting tree density, canopy cover, or structural components of the stand?
- Does the project have the potential to interfere with oak resource production, either on-site or off-site (e.g., removal of seedlings or saplings)?
- Does the project restrict the potential for natural regeneration of existing oak resources?
- Does the project violate any ambient air quality standard, contribute substantially to an existing or projected air quality violation, or expose sensitive receptors to substantial pollutant concentrations?
- Does the project conflict with established recreational, educational, religious, or scientific uses of the area?
- Does the project cause substantial flooding, erosion, or siltation?
- Does the project increase substantially the ambient noise levels for adjoining areas?
- Does the project cause an increase in traffic that is substantial in relation to the existing traffic load and capacity of the street system?
- Does the project substantially degrade or deplete groundwater resources?

Mitigation

CEQA-identified mitigations measures often form the basis for project approval. Municipalities are often faced with the difficult task of determining how to ensure that the measures are fully implemented. Mitigation strategies are complex for degraded oak habitats. Good mitigation measures must be developed in clear and explicit terms. Specifically, the measures should include how the mitigation will be implemented, who is responsible for the mitigation, where it will occur, when it will happen, and who will be responsible for monitoring its success.

The ultimate goal for any mitigation should be to try to maximize the positive aspects of the project for the plant community or wildlife habitat being affected. A number of mitigation measures have been proposed and developed as a means to offset the loss of resources. These include on-site mitigation, off-site mitigation, pooling of project mitigations to a designated area or region, and the use of mitigation fees and other marketable mitigation credits. To assist all parties when addressing mitigation strategies ask the following five questions about each mitigation measure and try to obtain the required information.

Question	Requirement
Why?	State the objective of the mitigation measure and why it is recommended.
What?	Explain the specifics of the mitigation measure and how it can be designated and implemented. Identify measurable performance standards by which the success of the mitigation can be determined. Provide for contingent mitigation if monitoring reveals that the performance standards are not satisfied.
Who?	Identify the agency, organization, or individual responsible for implementing the measure and monitoring the results.
Where?	Identify the specific location of the mitigation measure.
When?	Develop a schedule for implementation.

Traditionally, mitigation activities in oak woodlands have focused on replanting efforts to address tree loss. However, it is becoming apparent that replacement seedlings as a mitigation measure for removal of older stands of trees cannot meet the immediate habitat needs of forest-dependent animal species. This realization has expanded the discussion beyond simple replanting schemes as a means of mitigating impacts. If mitigation strategies should include replanting, an alternative approach is to think about replacing *acres* lost instead of simply *trees* lost. Both the subdivision ordinance and the general plan open space element can require 1:1 or even 2:1 protection of oak woodland for each acre lost.

A comprehensive approach to mitigation should include a number of alternatives that can be used singularly or in combination to reduce habitat loss. These include (CEQA Guidelines § 15370) the following possible mitigation strategies that can easily be applied to projects proposing impacts on oak woodlands and trees:

- Avoid the impact altogether by not taking a certain action or part(s) of an action. In other words, if trees or stands are on the proposed project site, how can the project be amended to eliminate the need for tree removal? An example of this mitigation would be redesigning a project to avoid an existing stand of trees by redirecting a road, or redesigning an agricultural operation to maintain viable oak habitat. However, it should be recognized that protecting a few large trees does little to mitigate losses of wildlife habitat or open space. Planting and maintaining larger stands of trees of different age classes should be considered to provide habitat values for on-site mitigation.

- Minimize impacts by limiting the degree or magnitude of the action and its implementation. Specifically, if trees must be removed, how can the project be amended to remove the least number of individual trees? An example of this mitigation would be redesigning a project to stay within the existing “footprint” of a previous project. Mitigation measures for aesthetic or historic values of oaks may be largely restricted to an on-site measure that protects or avoids the trees.

- Rectify the impact by repairing, rehabilitating, or restoring the impacted environment. Examples of this mitigation would be a stipulation for riparian restoration associated with the project as a means of improving the overall condition of the site, or repairing, rehabilitating, or restoring a riparian area that may have been impacted from a previous land-use project.
- Reduce or eliminate the impact over time by preservation and maintenance operations during the life of the action. Another way to consider this approach may include the establishment of a "reserve" area in the site that will be managed for the specific purpose of oak conservation. An example of this mitigation would include designating a "reserve" area in the project site. Where appropriate, the reserve could be memorialized through the use of a conservation easement or other appropriate planning mechanism.
- Compensate for the impact by replacing or providing substitute resources in the environment. Examples of this mitigation would be planting large container-grown trees, with appropriate irrigation, rather than seedlings to expedite the recovery of lost habitat components, or undertaking replanting schemes, off-site mitigation actions, or mitigation banking.

Replacement rates for planting mitigations should reflect land use, ecological conditions, and public values at the site. The ultimate goal in such a strategy should be tree establishment and long-term survival. Replacement rates should depend on the size of the replacement stock, that is, whether the stock is seedlings, 1-gallon or 5-gallon saplings, and so on, and the enacted horticultural practices should reflect commensurate practices necessary to maintain the planting to ensure establishment. Monitoring should be required to insure that the planting is successful well into the future (5 years).

Off-site mitigation measures, such as the application of conservation easements, open space dedication, or habitat restoration, may allow enhancement of biologically significant oak woodland habitats, but it should be viewed in the context of a spatially larger planting scheme beyond the immediate project site. An overview of Sonoma County's Open Space District is provided in chapter 7 for an example of a comprehensive planning approach aimed at mitigating resources across the landscape. Potential site-specific examples of project mitigation measures include

- fencing trees to prevent soil compaction during grading and construction operations
- retaining ecologically significant trees for wildlife needs (nesting, roosting sites)
- retaining ecologically significant stands of existing habitat
- including greenbelt easements, buffers, or setbacks along streams and other ecologically sensitive areas
- clustering housing and other construction and minimizing road density and width to preserve open space values
- considering open space dedications, acquisitions, and preserves
- protecting watercourses, springs, vernal pools, or other features that support resident wildlife, fisheries, and botanical species

Off-site mitigation measures (actions implemented away from the project site) are an option and may be appropriate for large projects where opportunities or space for on-site mitigations are limited. However, off-site measures should be considered sparingly and should not be viewed merely as a convenient way to achieve mitigation objectives. *Off-site mitigation proposals should be carefully considered so that the strategy is not abused.* Suggested criteria for identifying hardwood areas that might qualify as candidates for off-site mitigation include

- selecting oak species and site locations capable of ensuring adequate regeneration and endurance
- improving watershed values, including reducing erosion hazards, and/or improving stream corridors
- improving or expanding threatened species habitat
- maintaining habitat connectivity to improve biological integrity across the landscape
- selecting areas that potentially protect, promote, or improve locally significant oak resources

Conservation programs that include a variety of mitigation approaches may be encouraged by

- establishing covenants, codes, and restrictions
- providing written management guidelines or other educational materials to individuals and homeowner associations
- incorporating public works vegetation management activities, such as utility line tree maintenance, into broad-based oak conservation strategies
- establishing leasing arrangements with local livestock operators that maintain contiguous acres of functional oak woodland habitat

In some instances it may be appropriate to consider establishing a buffer between woodland preserves and high-density development. Buffers that provide physical barriers to domestic pets are important for reducing impacts to wildlife. In terms of wildlife habitat characteristics, fragmented woodlands are not as valuable as larger, contiguous stands. Linear woodlands are more easily influenced by adjacent activities and have proven to have negative influences on some wildlife species.

Ensuring Mitigation Success

CEQA authorizes levy fees to pay for monitoring. However, CEQA does not give an agency the authority to remedy violations of mitigation requirements. Most agencies have considerable authority under other state laws or local ordinances to ensure compliance. Compliance measures appropriate for consideration in oak-related mitigation include

- "stop work" orders
- revocation of project approval
- misdemeanor criminal sanctions
- performance bonds

For mitigation measures that may be initiated following project implementation or those that require maintenance over a protracted time, it may be necessary to secure a source of funds from the applicant to guarantee adequate support for mitigation monitoring. This may be especially true for open space management, and conservation easements, as well as for enforcing CC&Rs, educational requirements, landowner management activities, restoration, and off-site habitat enhancement. The method and schedule of payment for mitigation should be tied into final project approval. Details of the arrangement must be clearly articulated so that they are understood by all parties. That agreement should be clearly written in an agreement that becomes part of the conditions of approval.

For example, Sonoma County developed a valley oak mitigation fund as part of a broader valley oak protection ordinance to ensure adequate funding for off-site mitigation efforts. The fee schedule was developed on the basis of the size and number of trees to be removed.

Designing an Effective Monitoring Program

The most effective strategy for successful mitigation monitoring incorporates specific actions into the conditions for project approval. The project applicant and the lead agency should design this program cooperatively in order to ensure effective implementation. A monitoring program should

- describe the mitigation measures to be implemented in detail
- include measurable variables that will reflect effectiveness of mitigation
- describe how variables will be reported or monitored
- provide a monitoring or reporting schedule
- identify the person(s) responsible for on-the-ground monitoring activities
- provide for reporting, organizing, and management of data
- identify and provide for funding
- provide for enforcement
- identify contingency measures

By addressing responsibilities, costs, and products, expectations will be understood by the project applicant and the approving agency. The key to these advanced planning approaches is early consultation between the landowner or developer and the local planning agency. Such consultation should include a site reconnaissance or inventory before the planning process begins. In this way, instead of preconceived or generic formulas being used for site planning, the project can be designed in response to the site's constraints.

Table 6.3 identifies factors and potential problems that should be considered when using particular mitigation strategies. It also provides specific recommendations to address these issues.

Voluntary Planning Programs

Not all situations demand a regulatory response. Several other approaches have proven to be successful for the protection of oak resources. A number of incentives and management and educational programs can be made part of an integrated approach to oak conservation. These range from relatively simple and inexpensive programs to community-wide resource management plans. The following list indicates the scope of available approaches.

- Cities and counties can adopt a policy of using native trees as part of their landscaping operations.
- Local governments, schools, and utility companies can establish municipal nurseries or contract with commercial growers to provide a supply of locally derived stock for planting and give-away programs.

- Local government can provide, free of charge, the services of an arborist or natural resource specialist to advise homeowners and developers about care and protection of their trees.
- Conservation and open space districts can be publicly funded.
- Cities and counties can encourage a program of voluntary registry where landowners agree to protect their trees and abide by an environmental code of ethics on their land.

Communities can be proactive by identifying receiver sites where reforestation can take place. These receiver locations can be used for mitigating the loss of trees due to development or where on-site mitigation is infeasible. Almost every community has "left over" places along roadways and in interchanges, corporation yards, floodplains, and so on where trees can be planted and maintained. Site selection should be based on a master plan that minimizes the possibility that efforts would create islands of isolated habitat that will not adequately balance losses at other sites.

Local governments or nonprofit conservation groups can also acquire conservation easements, either through donation or purchase, that can accomplish long-term protection. It is a fairly widespread practice in development approvals to require the dedication of land for parks or schools. Such dedications are now being extended to open space and could easily be used to preserve oaks or to set aside receiver sites for restoration.

Environmental Quality Incentives Program

The Natural Resource Conservation Service (NRCS) developed the Environmental Quality Incentives Program to streamline their voluntary conservation programs and better assist farmers and ranchers who want to actively protect soil, water, and related natural resources. The program provides cost-sharing and technical assistance for conservation practices with eligible landowners through 5- to 10-year contracts. To be eligible, landowners must meet the conservation priorities established by their regional NRCS office with input from local resource conservation districts (RCD), Farm Service Agency, UC Cooperative Extension, and local residents. To obtain more information about this program and your area's conservation priorities, contact your local NRCS, RCD, or Cooperative Extension office.

Forest Legacy Program

The California Department of Forestry and Fire Protection (CDF) Forest Legacy Program identifies and protects environmentally important forestland that may be converted to nonforest uses. The program provides financial compensation for permanent conservation easements on forest land with significant ecological values. Forest management and recreational activities such as timber harvest, hiking, hunting, and fishing are usually permitted as part of the conditions of the easement. While this program was originally designed for coniferous forests, oak woodlands can be considered under it as well. To obtain more information about this program and your area's conservation priorities, contact your regional or state offices of the California Department of Forestry and Fire Protection.

Table 6.3. Concerns and constraints of oak tree and woodland planning measures

Planning measure	Concerns and constraints	Recommendations
Mature tree protection	Many die within 5 years of development from inadequate protection, improper grading, root trenching, summer irrigation, etc. Small trees are not protected; long-term maintenance of stand is often not provided.	Develop appropriate tree protective measures during project implementation. Provide for monitoring of tree health and survival. Consider performance bonds to insure success. Provide for sapling or seedling survival during project implementation. Provide educational materials to homeowners on values and protection of oaks in the landscape.
Relocation of mature trees	Extremely expensive and mortality is often very high.	Not recommended.
Tree planting	May require maintenance to insure survivability.	Provide appropriate care and protection from deer, rodent, or other grazing. Performance bond, maintenance contract, homeowner association fees, or other funding source may be necessary to ensure success.
Easements or open space with public access	Public use may cause conflicts with adjacent landowners and resource protection. Public open space next to ranches may increase livestock losses, trespassing, litter, and vandalism.	Provide educational materials to prospective neighboring landowners. Address zoning compatibility. Sites with natural features that may serve as buffers should be identified when considering potential open space and recreational sites. Other planning tools may lessen community conflicts from adjacent land use practices (e.g., right-to-farm ordinances). Inform new landowners of trespassing laws, leash laws, and right-to-farm laws. Covenants, codes, and restrictions (CC&Rs) may be used to restrict pet ownership or other activities that may impact conservation measures.

Planning measure	Concerns and constraints	Recommendations
Open space for wildlife and oak conservation without public access	May have to develop a management plan that addresses other resource issues to minimize conflicts, e.g., fire hazard reduction, noxious weed control, predator management. Should be part of a larger conservation strategy that includes lands that allow some public access to garner community support. Linear woodlands are more influenced by adjacent activities than circular ones due to the increased percentage of "edge." Conservation strategies should aim to connect isolated oak woodland parcels if possible. Mitigation values may be reduced or lost over time if adjacent land is developed. Woodland acreage should be sufficient to insure regeneration. Wildlife habitat may require additional protection from predation by domestic pets.	Provide for funds for management activities. Grazing leases may provide funding for management activities. May need to consult with range, forestry, arboriculture, or other specialists on management needs. Conservation strategies should be considered in areas zoned for compatible use. Optimize effects of projects by joining easements, parks, other open space projects where possible. Work with other resource agencies and organizations to optimize resource benefits. Allow land uses that are commensurate with successful regeneration. Consider buffers that provide physical barriers to protect adjacent lands from unwanted impacts.
Preserves	Preserves should be separated or buffered from high-density housing.	Provide for an additional buffer or low-density woodland zone.
Protection or restoration of other resources	Wetlands or riparian areas are sensitive to impacts and may affect some management options. Off-site woodland restoration should maximize benefits by enhancing wildlife habitat.	Avoid selection of sites downstream from sedimentation and erosion sources. Protection may be required from certain types of recreational use and livestock grazing.
Use of CC&R or homeowner associations to maintain woodland habitat	Lack of enforcement or management funds may fail to mitigate habitat damage.	Provide for fines, fees, bonds, or other means of achieving compliance with mitigation goals in the land title.

Private Lands Wildlife Habitat Enhancement and Management Program

The California Department of Fish and Game's Private Lands Wildlife Habitat Enhancement and Management Program (PLM) improves and conserves wildlife habitat while providing increased hunting opportunities on private land in California. To be eligible for the program, participants must complete a habitat assessment, identify habitat improvement actions, and develop and receive approval for a management plan. Once approved, the program can enable participating landowners to offer hunting opportunities beyond regular seasons, modify bag limits, and initiate other practices that allow for improved income. The program can also provide assistance for developing nonhunting wildlife activities such as bird watching, photography, camping, and hiking. Participants must pay an annual license fee and make a 5-year commitment to the program. For more information on this unique program contact your state or local California Department of Fish and Game Wildlife Management Division office.

Stewardship Incentive Program

The California Department of Forestry and Fire Protection Stewardship Incentive Program encourages landowners to actively manage their forest resources to ensure long-term economic and ecological benefits. Landowners are provided with technical assistance to develop a multiresource management plan that meets the landowner's objectives while protecting and enhancing resource values. In addition to receiving technical assistance, landowners are eligible for cost-share support of up to $10,000 per year to offset the costs of newly implemented management activities. This program applies to all forested lands with 10 percent or more tree cover, cropland, pastureland, surface-mined lands, and nonstocked forestland that will be converted to forestland as part of a management plan. Parcels of 10 to 1,000 acres (about 4 to 400 ha) are eligible. For information on restrictions of this program or to apply, contact your local or state office of the California Department of Forestry and Fire Protection.

The Forgotten Property Right: The Right to Protect Land

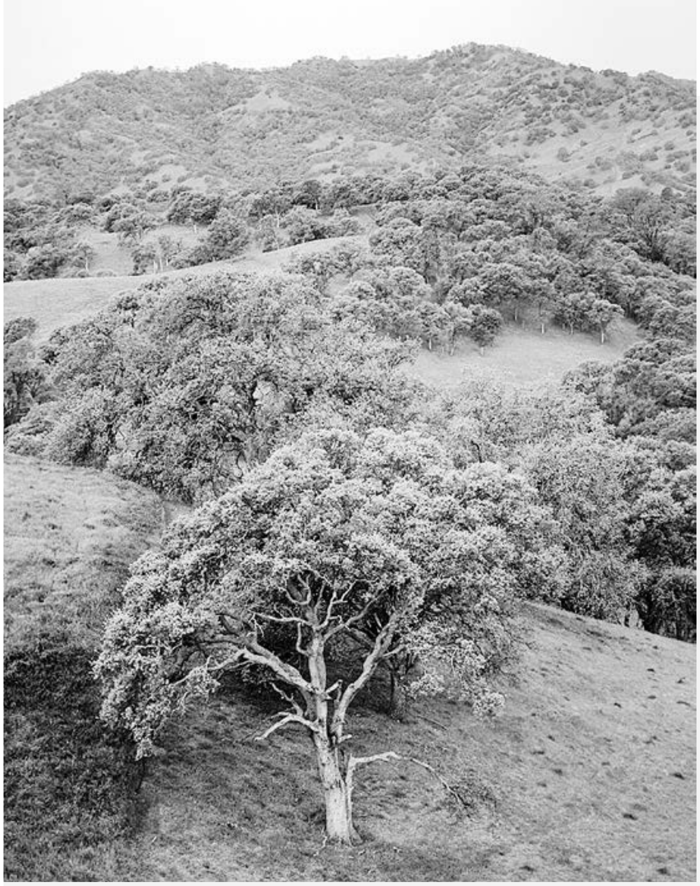
Just as landowners have the right to use and develop their land, consistent with government policies and regulations, they also have the right to protect their land for conservation purposes. The mechanism of choice for protecting privately owned lands is called a conservation easement. Planning professionals, well-versed in the regulatory mechanisms for land use and zoning, are often less familiar with this increasingly popular, legally binding, land-saving mechanism that has been used for decades to protect diverse California landscapes. Of course, no single conservation technique can by itself reverse the statewide decline of oak woodlands. Conservation easements can, on a site-specific basis, apply enforceable land-use restrictions that supersede zoning and protect oak woodlands from fragmentation and conversion to other uses.

What Is a Conservation Easement?

As used here, conservation easement (CE) is a generic term that covers restrictive easements commonly referred to as scenic, agricultural, open space, and forever wild. In California, enabling legislation exists under the California Conservation Easements Act of 1979 (Civil Code §§ 815-816); Open Space Easement Act of 1974 (Government Code §§ 51070-51097); and Scenic Easement Deed Act of 1959 (Government Code §§6950-6954). The Scenic Easement Act of 1959 is noted for its historic significance as the first such legislation in the United States. Though still on the books, it has become outdated, having been superseded by the Open Space Easement Act of 1974 and the Conservation Easement Act of 1979.

How Do CEs Work?

Technically, a CE is a negative easement in gross that runs with the land, passing with title from owner to owner. Being negative, rather than affirmative, means that it limits and restricts land use on the protected property. This relinquishing of



use and development rights distinguishes negative easements from affirmative ones. Affirmative easements grant use rights to someone else, the most familiar examples being rights-of-way for roads, pipelines, and transmission lines. A CE can be both negative and affirmative, such as when it protects land for conservation purposes and also allows recreational or educational pursuits that include access rights. The primary responsibility assumed by the government or nonprofit CE holder is the legal obligation to monitor and enforce the CE's provisions.

What Opportunities Exist for Using CEs To Protect Oak Woodlands?

The effectiveness and durability of CEs make them attractive to conservation-minded landowners, planners, land trusts, government officials, and others who seek long-term protection for oak woodlands. Government agencies often do not have the time or expertise needed to pursue voluntary, incentive-based land conservation strategies. Cultivating public-private partnerships between government agencies and qualified nonprofit organizations (land trusts) increases the effectiveness of both entities. Land trusts use landowner-friendly techniques, including CEs and tax benefits that help make land conservation affordable. Working cooperatively with landowners and public agencies, land trusts can play a vital role in accelerating and expanding on-the-ground protection for oak woodlands.

What Are the Benefits to Landowners for Voluntarily Granting CEs?

Certainly many transactions are financially motivated, but nonfinancial benefits are often important as well. The peace of mind that comes from protecting land can be its own reward. One farmer put it this way: "Nobody's gonna trick around with this land after I'm gone. That's a real comfort to me."

Sales and charitable gifts of CEs enable landowners to receive financial benefits without giving up title to the land. Financial benefits of CE transactions include cash proceeds (from sales) and tax benefits (from gifts and sales). Sales can be for fair market value or "bargain sales" (part gift, part sale) for below-fair-market value. Market value is established by a professional appraisal report that estimates the current value of the land, both before and after the CE restrictions, based on comparable sales of like properties. The difference between the "before" (without the CE) and "after" (with the CE) values is the fair market value of the CE. The kind and amount of financial benefits depend on the diminution in value attributed to the CE and whether the transaction is a charitable gift, bargain sale, or market sale.

Income tax deduction

Income tax benefits associated with gifts of CEs, including bargain sales, provide an important financial incentive to landowners. To qualify as a charitable gift the CE must meet Internal Revenue Code § 170 requirements for a conservation contribution, be given to a government entity or qualified conservation organization (land trust), and be granted with donative intent. "Donative intent" means that the CE must be given freely, with no expectation of benefit, and the gift must be irrevocable, without strings or contingencies. When landowners donate CEs to qualified entities, the amount of their contribution generally equals the fair market value of the CE at the time of the contribution.

Capital gains tax reduction

The income tax deductions earned by gifts and bargain sales can be used to reduce capital gains tax. In planning land and CE gifts, timing is an important factor for maximizing tax benefits. Timed properly, the charitable deduction earned by the gift can offset capital gains tax liability from the sale of appreciated assets, such as stock or real estate. For example, because a bargain sale is part gift and part sale, the charitable deduction earned by the gift portion can offset capital gains tax liability, if any, resulting from the sale.

Estate tax reduction

The most important estate tax benefit of a CE is that it reduces the value of the estate, thus reducing or eliminating estate taxes. This subtraction from the value of estate property is available regardless of whether the CE is sold or donated. With the enactment of the Taxpayer Relief Act of 1997, an additional tax benefit is available for the families of CE donors. Fair market sales of CEs do not qualify for this benefit. This new 40 percent exclusion (Internal Revenue Code § 2031(c)) is limited to $500,000 per estate, and additional rules and conditions must be met. This new exclusion is a significant incentive to CE donors seeking estate tax relief.

California tax credit

The year 2000 marked the passage of California's Natural Heritage Preservation Tax Credit Act (Public Resources Code § 37000 et seq.). This legislation provides state income tax credits for land and CE donations to nonprofit organizations and state agencies. The Act, which is administered by the State's Wildlife Conservation Board, authorizes $100,000,000 in tax credits over a 5-year period (2000-2005) based on 55 percent of the value of the contribution.

Property tax reduction

Though it is difficult to say with certainty that a CE will lower property taxes, it may. Certainly granting a CE will neither increase property tax nor trigger reassessment under Proposition 13. Property taxes will either be reduced or unchanged. A CE may lower property taxes by reducing the land's development potential and consequently its fair market value. Property tax would be unchanged for land already taxed at a low rate, such as a farm or ranch under a Williamson Act Contract. Land being taxed at a high rate before the CE could be taxed at a reduced rate afterward, based on the diminution in value attributed to the CE.

Case Study: ***Oak Policy Development—Lessons from Santa Barbara County***

In the fall of 1997 a concerned public alerted the Santa Barbara County board of supervisors that many hundreds of mature valley oaks and live oaks were being cleared to make way for a new vineyard near Highway 101. In response, the board directed the planning and development department to recommend a strategy for protection of native oaks.

Planning staff reported on the vineyard boom that was then in full swing and on the status of the county's oaks. They concluded that some agricultural projects were being installed with little or no oak removal, while others were having substantial impacts. One operation in particular had removed approximately 20 percent (several hundred) of the valley oaks in Los Alamos Valley, while still another removed 400 mature live oaks to accommodate a 150-acre (61-ha) planting of grapes. Furthermore, it was estimated that countywide, valley oak woodland had been reduced by more than 80 percent in the past two centuries, with less than 10,000 acres (about 4,000 ha) remaining. Additionally, although live oaks were regenerating adequately in most areas, their acreage had clearly decreased over time.

Rather than adopt an urgency ordinance that could have been turned into a permanent new law and implemented in a matter of weeks, the supervisors initiated a public collaborative process to design a program that would balance agricultural needs with oak protection. That initiative was started in 1998. In 2003, the county board of supervisors adopted an oak preservation law, though some farmers were not entirely happy with the product and initiated a suit challenging it. However, the lessons learned are the fruits of our experience, and that is what this exercise offers to landowners, farmers, activists, and officials in other counties and cities interested in regional oak conservation planning.

The Public Process, Part I

The collaborative process in Santa Barbara County consisted of 16 public meetings, each of which were 3 hours in duration, extending over a 14-month period. Although the crowd sometimes swelled to 60 or 70 people, the meetings were anchored by a core group of about 25 stakeholders who consistently attended. The decision to keep the process inclusive by not establishing a committee of specific individuals, although at times difficult to facilitate, ultimately proved worthwhile. It made the process more inviting to people who might otherwise have stayed away. The open forum also provided for refreshing divergence when a stakeholder who was not an activist or political fixture attended and provided a novel, honest, practical perspective.

The planning department also engaged in a concerted effort at widespread noticing, including posting notices in farm supply outlets in the most rural parts of the county in addition to standard mailings and newspaper ads.

One of the most rewarding projects organized by county staff was a collaborative process to organize a local oak symposium in June 1998. The speakers included University of California and Integrated Hardwood and Range Management Program oak specialists speaking on oak regeneration and statewide status, as well as government agency and nonprofit foundation experts speaking on funding, incentives, and estate planning. But working ranchers and farmers were also invited to talk about what they've learned and observed in their combined centuries of experience managing their hardwood rangeland acres. Their presentations brought home the reality that oak woodlands are important to everyone and educated many participants about the strong, often unsung conservation ethic among farmers and ranchers. It may not have brought everyone to agreement on how to protect oaks, but common ground was much less of a slogan and more of a certainty after those talks.

The result of the collaborative process was a mixed bag by any standards, but the benefits far outweighed the shortcomings. Traditional political and philosophical adversaries began a dialogue for the first time in a public setting, and that dialogue continues. Farmers and environmentalists learned much from each other in those hours of discussion around tables in the rural church hall where we met. In addition, the group agreed to an excellent set of recommendations for mapping oak woodlands, pilot regeneration projects, education, and incentives. These recommendations led to a pilot mapping study, the symposium mentioned above, and two county-funded oak planting projects in which more than 500 valley oaks were planted.

Unfortunately, the entrenched positions of some key participants caused them to walk away before a final agreement on strategy. The initial stated goal of the process was to "create a clear set of guidelines to avoid/prevent large-scale oak removal and to maintain viable oak habitats. Create oak removal thresholds beyond which a site-specific discretionary review will be required. In some cases, mitigation will be acceptable." It was generally agreed that oaks, particularly valley oaks, did merit protection. The disagreement was over how to get there.

Refining the Program

After the collaborative process concluded without final agreement the board of supervisors directed staff to conduct more public workshops and to refine the regulatory framework envisioned in the collaborative meetings. The program has two components: a set of policies and actions that would call for oak protection and funding for incentives, outreach, and education; and an ordinance. The greatest challenge of this second phase was to develop the regulatory structure that was invented in the collaborative process in order to make it practical.

In refining the program, the participants may have confronted an immutable law (at least for our county) of tree protection ordinances: moderation leads to complexity.

The overarching goal of the program was to balance oak protection with encouragement of agriculture and agricultural expansion. That ruled out a simple ordinance that would require a permit for any oak removal at all, or one that would allow so much oak removal that a permit would almost never be needed. The regulatory component of the program needed to provide for a fair amount of exempt oak removal in order to allow routine ranch maintenance or moderate expansion into oak woodlands and savanna without the need for permits and the paperwork and replacement tree plantings that would be required.

To be equitable, it had to allow differential exemptions on large versus small ranches. The result was a table identifying a range of ranch acreages, allowing different levels of removals for each acreage class. (Percentage-based removal thresholds were considered but rejected due to landowner objections that a tree survey would be needed for every removal and concerns over the relative accuracy of canopy calculations). The result was a program that is fair, balanced, and somewhat complex.

The Public Process, Part II

The next step on the road to a county oak protection plan (the step that the participants are still in at this writing) was public hearings before the planning commission. Following the planning commission's recommendation, the final decision will rest with the board of supervisors.

Developing a range of options based on public input is essential when going before decision makers. Planners prepared an environmental impact report (EIR) for the program, and, as with all EIRs, they had to include and analyze alternatives. This allowed for a fairly thorough exploration and fleshing-out of the different ideas that were floated in the years of public comment and workshops. The options included a canopy percentage–based regulation, voluntary guidelines only, a strict ordinance, a permissive ordinance, and a "hybrid" plan that relaxed thresholds for live oaks but tightened them for valley and blue oaks. As it turned out, after the analysis and continuing discussions internally and with the public, staff recommended one of the alternatives, a variation of the original project. Obviously, the board of supervisors may choose a different alternative or a creative combination of elements of two or more of the options. One additional note of interest on the EIR: In addition to analyzing potential impacts of the program to biological, geological, aesthetic, and other resources, the report analyzed impacts on agricultural resources as well. It was a learning experience for staff and also contributed to the goal of full disclosure for all stakeholders.

The collaborative process had been over for more than a year by the time the planning and development department brought forward their preferred program and a range of options. Unfortunately, during this time the spirit of compromise had slightly diminished among the public. The first challenge was an especially colorful array of misinformation and misunderstanding. Rumors spread that "tree police" would be invading private land at a cost to the taxpayer of millions of dollars per year; that permits would be required to replow fields of broccoli and cabbage (whether oak trees were present or not); and that farming and ranching were dead in Santa Barbara County. To dispel these fears, the staff wrote a report, complete with hypothetical scenarios, photos, and real-life examples that explained in detail exactly how the proposed program would affect landowners. The goal was to disclose all impacts on farming as well as on oaks and wildlife, whether good or bad. It turned out to be well worth the time and energy to produce such a thorough report: having all of the facts clearly presented helped the county's planning commissioners arrive at a positive recommendation.

Looking to the Future

The heart of the current debate over the future of the county's privately owned oak woodlands is categorized by three positions: to go forward with the regulatory, education, and incentive elements that make up the proposed oak protection program; to shelve the proposed program and rely instead on voluntary guidelines; and to combine both of them in a creative way. Each position has merits. Voluntary programs are built on trust, which could improve the relationship between the government and the agricultural industry and avoid the perception of oppressive regulations. At the same time, planners recognize that landowners who operate with only "the bottom line" in mind will not be bound by guidelines based on conservation goals.

Planner's Wish List

Several informational items would have helped county staff and citizens during the long policy development process. One of the repeated requests from the public was for more and better information on local oak distribution. Oak woodland maps produced by various agencies were not accurate or detailed enough for the participants to feel that the work was backed by sound data. In response, the county sponsored an oak mapping pilot study for a small portion of the county. Although the results were excellent, woodland mapping is still needed for the remaining areas. In addition to mapped information, a summary of the status of the county's oak resources, by species, acreage, and so on would have been, and would still be, very helpful.

The public disagreed on whether oaks were regenerating well, questioning whether there was a net decline in woodland acreage. To help resolve this situation, a program of statewide monitoring that would measure the effectiveness of voluntary versus regulatory oak protection measures would be extremely valuable. After contacting jurisdictions around the state that had both kinds of programs, the Santa Barbara County planners had only anecdotal information to bring to their decision makers, who were faced with the task of weighing the options with limited reliable information.

Since oaks have become a public topic in Santa Barbara County, staff has watched as unmitigated removals continued, albeit at a slower pace. Finally, information on what kind of performance to expect from oak plantings, based on local conditions and species, would have helped produce realistic guidelines for when to accept mitigation plantings as healthy and established.

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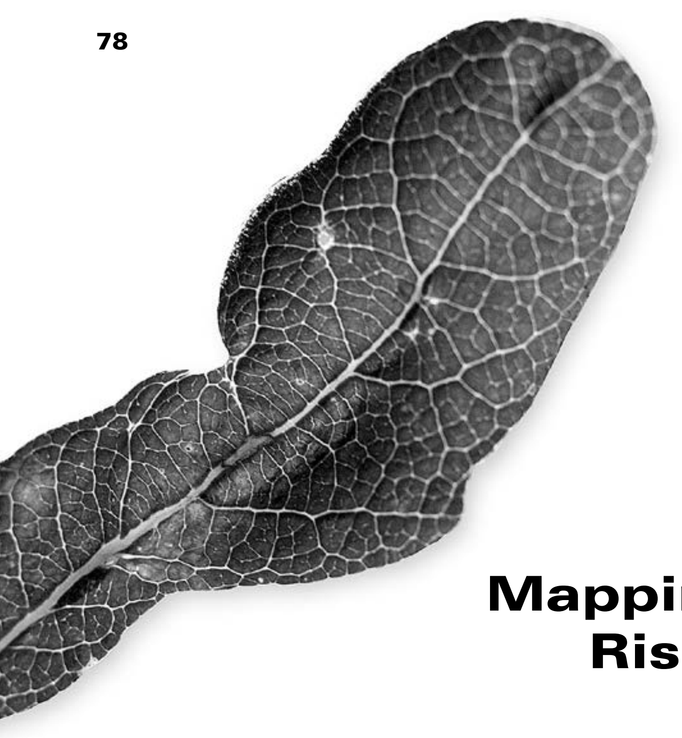


Chapter 7

Mapping Resources and Modeling Risk for Improved Land-use Planning

Adina Merenlender, Colin Brooks, Bob Johnston, Shawn Saving, Greg Greenwood, Andrea Mackenzie, and Gregory A. Giusti

The land-use planning process clearly needs better information to help steer development toward less ecologically sensitive areas and to help prioritize areas for conservation. Mapping oak woodland resources is usually the first step in protecting the myriad natural and agricultural resources found in a given area or region. However, planners often need more than resource maps in order to minimize the impacts of future development. The relative biological and social values of sites across a county is important, as is the relative threat to these resources given expected patterns of development. Any decision-support system that could help planners conserve oak woodland resources in a private landscape must include the location of important resources and the potential threats to these resources from continued development. Recently, scientists have integrated spatial information about natural resources into land-use change models in order to address this need. Land-use change models provide a popular new tool for analyzing the interactions between development patterns and natural systems that support ecological processes and environmental goods and services.

These analyses are rapidly evolving. Geographic information systems (GIS) and more-advanced computing power have been central to the development of these land-use planning tools. A GIS is a computer mapping and analysis program that allows large amounts of spatial information to be integrated with associated nonspatial information. For example, digital maps of woodland cover can be integrated with parcel data to identify parcels that contain oak woodlands. Landscape ecology principles have also been applied using these maps to prioritize large continuous woodland patches of a certain size for habitat conservation.

How Has GIS helped?

GIS has made it easier for scientists to develop spatially explicit land-use change models. These models can help communities forecast and evaluate the potential consequences of policy decisions and other actions on land-use patterns and oak woodland conservation. Generally, these models are either based on rules or on statistical analysis of past patterns of change. The former predicts land development following established planning documents (e.g., the general plan) using stated assumptions about the rate and distribution of growth, while the later extrapolates future development from analysis of past growth patterns. The major assumption of statistical models is that future development patterns will be similar to those in the past. This is a reasonable assumption at a large scale because new urban and rural growth usually results from spillover, or "sprawl," from the existing urban footprint. However, the more-exact or fine-scale patterns of future development (e.g., which side of the city center will be developed first) is often influenced by city and county planning and is best predicted using a rule-based model that takes into account planning (e.g., land-use zoning). Rule-based models rely on more subjective criteria such as zoning that can be overturned in the political arena, as compared to statistical models that base growth predictions on more objective analysis. Results from any land-use change model should be viewed in the context of the quality of the data, assumptions, and limitations of the model.

A useful exercise to appreciate how mapping oak woodland resources and spatially explicit land-use change models can help planners protect natural resources is to examine existing examples. We present four examples of integrating natural resource information into land-use planning using GIS for California's privately owned oak woodlands.

I. Mapping and Quantifying Policy Impacts*

Local regulatory policies addressing oak woodland conversion are continually evolving in Napa, Lake, Santa Barbara, and Sonoma Counties. While some conversions, such as vineyard development, can have an array of effects on forests, watersheds, wetlands, fish, and wildlife (Garrison 2000), local policies usually address only soil erosion and water quality. Given the ecological ramifications of the net loss of oak woodlands, some policies have required farmers to register new vineyards with the county, representing some of the first limitations on agricultural development in California.

For an in-depth examination of Sonoma County's local regulations, we used a geographic information system to analyze Sonoma County's Vineyard Erosion and Sediment Control Ordinance adopted in February 2000, which sets standards for the development of new vineyards on certain slopes. The purpose was to quantify the areas that would be more and less affected by new regulation, in order to better evaluate the policy and assist decision makers. Select criteria were used to create three levels for the oversight of vineyard projects (see table 7.1):

- Level I. The Sonoma County ordinance assigns new plantings of vineyards on minimal slopes (lower than 15%, 10% for highly erodible soils) as Level I. At this level of regulatory oversight a 25-foot (7.6-m) stream setback and notification of the agricultural commissioner is required.
- Level II. These are projects designated by areas of moderate slope (15% to 30% slope, 10% to 15% for highly erodible soils). Level II projects are required to develop a certified erosion control plan that can be prepared by a qualified person with experience in preparing such plans.
- Level III. This level of regulatory oversight requires a certified erosion control plan that must be prepared by a qualified professional. Level III sites have average slopes from 30 to 50 percent (15% to 50% for highly erodible soils).

*_Source:_ Brooks and Merenlender 2000.

Vineyards that fall in Levels II and III must also have a 50-foot (15.2-m) setback from the top of the stream bank, although variances can be applied for. In all cases, depending on the percentage of slope, stream setback zones are established, and with certain limited exceptions, development on slopes greater than 50 percent is prohibited. The ordinance identifies seven soil types as highly erodible. Slope categories for vineyard replanting are treated slightly differently. Our research is

Table 7.1. Criteria for Sonoma County hillslope vineyard ordinance

	Slope	Stream setback	Erosion control plan required	Comments
Level I	< 15% (10% for highly erodible soils)	25 ft	no	notification of agricultural commissioner required
Level II	15–30% (10–15% for highly erodible soils)	50 ft	yes	erosion plan must be prepared by a qualified person with experience
Level III	30–50% (15–50% for highly erodible soils)	50 ft	yes	erosion plan must be prepared by a qualified professional

focused on potential impacts of future vineyard expansion and does not address replanting levels. The ordinance does not address upland vegetation removal and other habitat conservation issues.

Spatial Analysis

The GIS we developed for vineyards across Sonoma County's landscape enabled us to evaluate these new regulations. We mapped the parts of Sonoma County that fell into the three levels defined by the Vineyard Erosion and Sediment Control Ordinance. We wanted to examine areas that would be more and less affected by this policy and quantify the amount of current and possible future vineyard areas that fall into the various levels of regulatory requirements.

We mapped areas that fall into each regulatory level for new plantings defined in the Sonoma County ordinance (fig. 7.1). Where we had digitized soils data into a GIS format, these levels reflect whether the site is on erodible soils; otherwise, the site was analyzed based on slope class alone.

For the entire 1,015,179 acres (410,840 ha) of Sonoma County, 38 percent fall into Level I, 23 percent into Level II, and 28 percent into Level III. About 11 percent have slopes greater than 50 percent. We used a digital layer showing vineyard locations established through mid-1997, which allowed us to calculate how much of this vineyard land would fall into the various regulatory levels if the policy had been in place at the time these vineyards were established. In this case, less than 1 percent of the vineyards established prior to 1997 were planted on sites that would have been entirely restricted by the proposed policy (slopes greater than 50%); very few (5%) would require Level III regulations, and only slightly more (11%) would require Level II regulations.

To estimate the percentage of suitable acreage left that falls under this ordinance, we began with the amount of acreage that was planted from June 1990 through June 1997, or 11,663 acres (4,720 ha). We made the assumption that the same number of acres would be developed from 1998 through 2005, a conservative estimate of growth since projects totaling close to 9,000 acres (3,640 ha) had been submitted to the agricultural commissioner's office by the end of 1999. Using the model to identify areas suitable for future vineyard development, we identified the most probable 11,663 acres that were as yet undeveloped (Heaton and Merenlender 2000). The areas likely to be developed, if vineyard development continues, fall into the levels of the ordinance in a fashion similar to the already developed vineyards, in that 84 percent fall into relatively flat areas subject to Level I regulations.

We also examined how future areas for vineyard development would be affected by the Sonoma County ordinance by calculating the areas that fall into the different slope categories (Levels I, II, and III) for all of the acres mapped as having a relative probability of being suitable for vineyards greater than 0.5 acres in our model. We conclude that most future vineyard development in Sonoma County will fall under Level I, and no more than 36 percent of future vineyard development, and more likely closer to 20 percent, will fall under the more stringent regulations requiring 50-foot setbacks and an erosion control plan. Before the ordinance was adopted, we provided analysis to the committee that developed the ordinance, the county board of supervisors, and the public. We hope continued use of this approach helps the public and policy makers quantify the implications of policies for agricultural development and environmental protection.

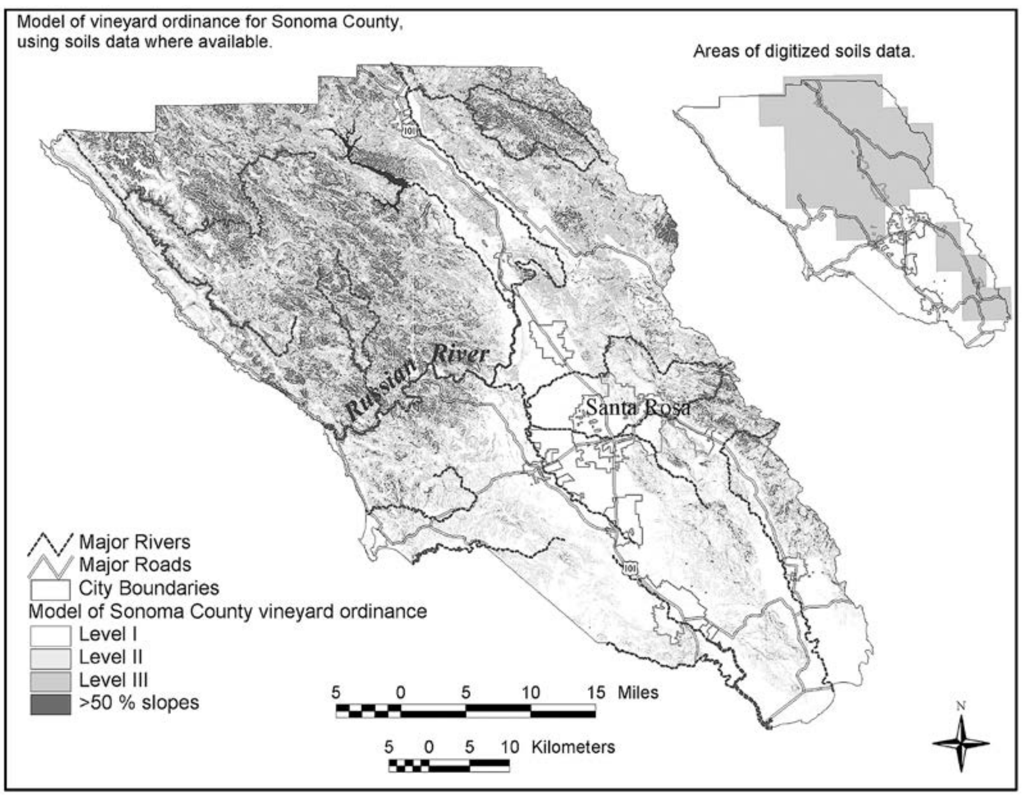


Fig. 7.1. Model of vineyard ordinance for Sonoma County, using soils data where available. Level I requires notifying the agricultural commissioner's office and a 25-foot stream setback. Levels II and III require a certified erosion control plan for sites on slopes averaging between 15% and 30% slope (10 to 15% for highly erodible soils) and 50-foot stream setbacks.

II. Using UPlan to Forecast the Impacts of Exurban Development on Wildland and Farmland in Sonoma County, California

Many existing models that predict land-use change do not effectively address exurban growth, a widespread type of low-density development that is impacting wildland

and farmland. To rectify this problem, we have developed a spatially explicit rule-based development model called UPlan. In order for a forecasting model to be most effective as a support tool for planners and local decision makers, possible changes to the development "rules" (different planning scenarios) should be able to be compared to determine the influence on the model outcomes. UPlan can project several land uses in size increments roughly matching development parcel sizes. The model is free and easy to reprogram.

- UPLAN is a GIS-based model for testing urban growth scenarios. It is written in Avenue for running in ArcView version 3 with Spatial Analyst on a personal computer.
- UPLAN is interactive, that is, the user can change the population growth rate or other basic assumptions such as employees per household, households per acre, and employees per acre. The user can also change the assumed proportions of land-use types, such as high-density commercial versus low-density commercial, or high-, medium-, and low-density residential. The proportions of employment land-use types can also be changed. All variables have default values.
- UPLAN uses input data layers that are widely available in the United States. We operate on 50-meter grid cells, so small urban infill sites and individual rural residential sites can be represented.
- UPLAN uses transportation and utility services variables as attractiveness factors. It then allocates land uses in order of bidding ability in the market (industrial, commercial high-density, residential high-density, commercial low-density, residential medium-density, residential low-density).
- The user can set various environmental and social constraints to growth, such as steep slopes, areas with shallow groundwater, wetlands, or surface water bodies with a buffer of any size. One can also specify various levels of land-use plan compliance, ranging from none to using only the industrial designations to one-way zoning to two-way zoning.

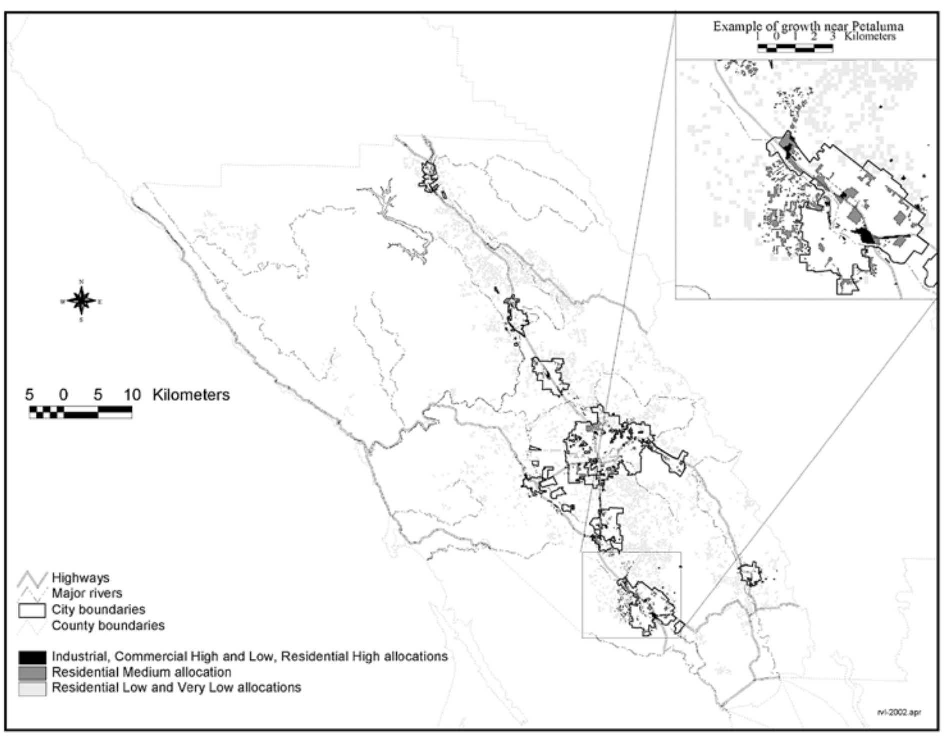


Figure 7.2. Land use in Sonoma County predicted by UPlan when agricultural land designated as 40-acre parcels or smaller is not protected from development.

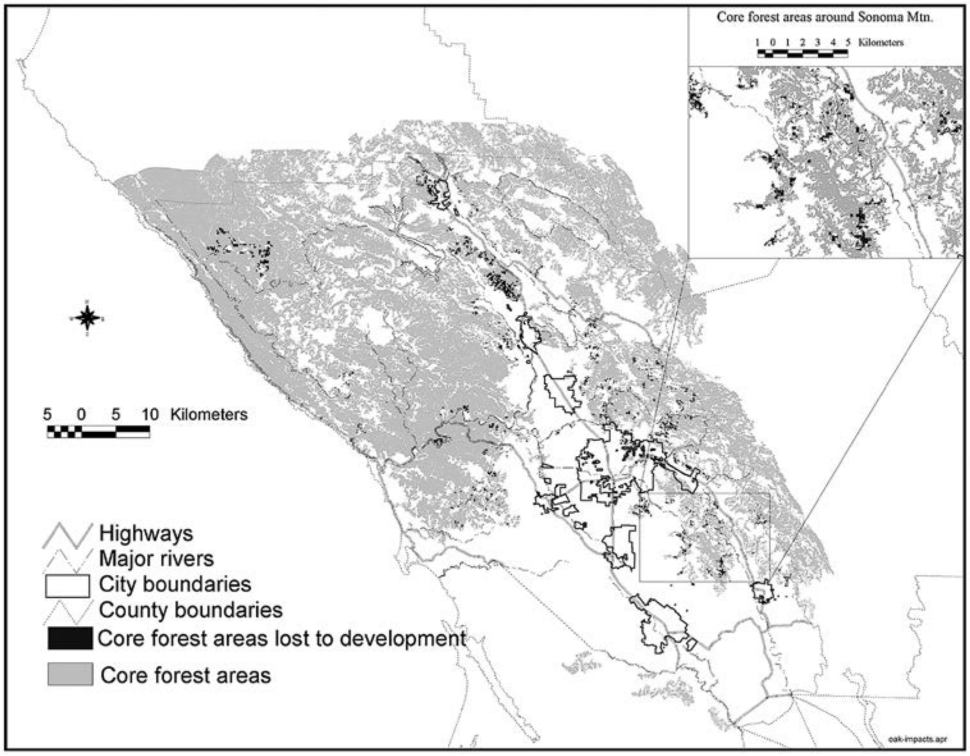


Figure 7.3. Core forest areas in Sonoma County and those impacted by development when agricultural land designated as 40-acre parcels or smaller is not protected from development.

- Policy tests that can be undertaken include general plan changes, urban growth boundaries, habitat/open space preserves, riverway/floodplain protection, new freeways and roads, and new rail transit lines.
- The growth impact models work from the urban layer for the future year and other data layers. Models include habitat damage, erosion potential, costs from flooding, costs from wildfires, and local service costs.

We modified UPlan for Sonoma County to compare the impact of various development policies on forest lands, woodlands, and intensive agriculture (Merenlender et al. 2005). Sonoma County has an estimated 27 percent of the population living at low densities (<1 unit/0.8 ha [2 acres]). UPlan Sonoma projects future low-density residential development, in addition to higher intensity land uses such as commercial and high- and medium-density residential (fig. 7.2). The results are primarily determined by converting the estimated future population growth into acres needed for commercial and residential development using housing characteristics, the pattern of existing development, and the county general plan, along with nine city plans.

Comparisons are made among different agricultural land protection policies to assess differences in the extent and density of development that would impact existing wildland and farmland by 2010. The three different land-use scenarios that are currently being debated at the local level were modeled: all agricultural land remains protected from further development; only agricultural land with a designated residential parcel size of 16 hectares (40 acres) or more is not subject to further development, allowing for development in agricultural land designated as 4 to 16 hectares per unit (10 to 40 acres per unit); and no agricultural land is protected from development.

The results reveal the extent and amount of continuous forest land that is at the greatest risk of fragmentation and associated increases in edge habitat (fig. 7.3), and the amount and location of cultivated land that could be lost. For example, 73 percent of remaining core forest land is predicted to be comprised of edge habitat (within 500 meters [0.3 mile] of development) if the land currently zoned as agriculture is not protected from development. Surprisingly, this same policy scenario barely increases the loss of cultivated land because most of the development is allocated to undeveloped or grazing land. Allowing small agricultural parcels (< 16 hectares [40 acres]) to be developed, a common practice, results in four times the amount of cultivated land lost. If the current pattern of development continues in Sonoma County, existing open space will be greatly impacted by low-density residential development. UPlan can assist communities to grow in ways that preserve the environment, agriculture, and open space, and, in doing so, help maintain the quality of life.

III. El Dorado County Planning Program Challenges in an Urbanizing Forest

We modeled future development in El Dorado County, California, a rapidly developing rural region of the central Sierra Nevada, to assess the ecological impacts of expanding urbanization and the effectiveness of standard policy mitigation efforts.

Using 1990 hardwood rangelands pixel data and county parcel data, we constructed a footprint of current development and simulated future development using a modified stochastic flood-fill algorithm. Incorporated into our model were constraints to development from the county's general plan (high slope, stream buffers, and oak retention) and the parcel data (public ownership and easements, and existing development). To evaluate policy options facing the county board of supervisors, we altered these constraints in likely combinations such as wider stream buffers, set-aside ordinances, regional clustering, and acquisition programs. The models overlaid development outcomes for each scenario onto the vegetation data and calculated metrics of habitat loss and fragmentation for all cover types (wildland) and for oak hardwood types only.

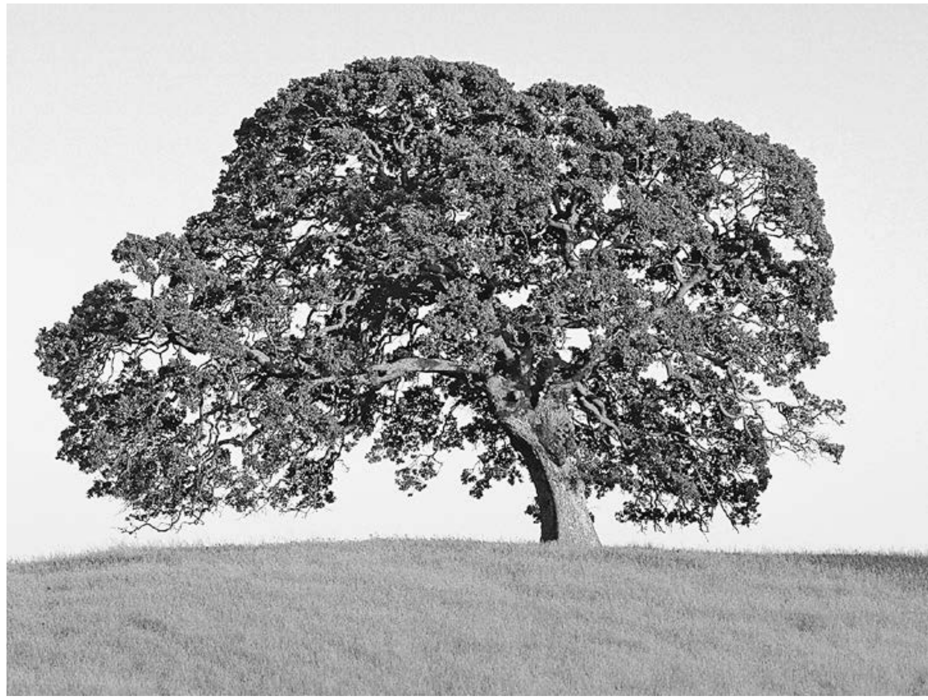
Policy alternatives ranging from existing prescriptions to very restrictive regulations had marginal impact on mitigating habitat loss and fragmentation. Historic land parcelization limits effective mitigation of development impacts by general plan prescriptions that apply only when a parcel requires subdivision before development (current policy). Options such as countywide ordinances or downzoning were more effective in preserving habitat and connectivity, but they may not offer enough extra protection to offset the large investments of political capital required for implementation. The natural latticework-like distribution of hardwoods in the region also contributes to this ineffectiveness, as even low densities of development can cause significant fragmentation. Custom, parcel-based acquisition scenarios minimized habitat loss and maximized connectivity. Better analysis and review of public policy and planning design may be a more effective smart growth tool to minimize negative impacts of development than generic policy prescriptions.

IV. Sonoma County Acquisition Plan 2000: A Tool for Conserving Oak Woodlands

Sonoma County encompasses over one million acres of hills, mountains, valleys, and river drainages, including the 1,485-square-mile (3,800-sq-km) Russian River watershed. Numerous habitats are found throughout the county, as well as many plant species, some of which are endemic to this area. Regardless of the county's multiple natural heritage features, no natural landscape captures the feeling of

Sonoma County more than its oak-studded plains and woodlands.

Planners at the County's Agricultural Preservation and Open Space District are working to ensure that these signature oak woodlands and their tremendous biodiversity are a priority for land conservation. In July 2001, Sonoma County adopted Acquisition Plan 2000, a countywide resource assessment and conservation plan that will direct the district's land acquisition efforts to agricultural, natural resource, greenbelt, and recreational lands that merit protection most.



About the District

The district permanently preserves agricultural and open space lands for future generations. Created by voters in November 1990, it is one of the top ten largest farmland and open space preservation programs in the nation and the first special district established for the purpose of protecting agricultural lands. The district is one of the few jurisdictions in the nation to fund its land conservation activities with a sales tax, which generates about $13 million annually. The voter-approved sales tax that funds the district's agricultural and open space acquisitions over a 20-year period expires in 2011.

The district's primary tool for acquiring interests in land is the conservation easement, which limits development and other uses of the property to protect its conservation values while leaving the land in private ownership. To date, the district has completed 80 land conservation projects and protected over 27,000 acres (8,000 ha) of agricultural and natural lands at a cost of $50 million.

A Science-Based Conservation Plan Takes Shape

In February 1999, the district and the University of California's Integrated Hardwood Range Management Program (IHRMP) entered into a research agreement to develop a systematic plan for open space acquisition in Sonoma County. Initially, geographic information system (GIS) analysts compiled available digital information on the agricultural, open space, and natural resources of Sonoma County. Using conservation science, GIS technology, and landscape-level planning, IHRMP staff and district planners drafted open space maps that identify and prioritize lands of high conservation value. These maps were reviewed, critiqued, and updated by a broad spectrum of local agricultural, planning, and natural resource professionals invited by the district to share their specialized knowledge about Sonoma County. Based on the open space maps developed by the University, and with input from a working group of district advisors, an acquisition strategy was developed for four distinct acquisition categories that represent the district's conservation mission and priorities: agriculture, greenbelts, natural resources, and recreation.

New Tools for Conservation

This new plan includes a consistent and scientific rationale for prioritizing certain areas of the county for conservation; objective criteria for evaluating the conservation potential of individual properties; and a GIS database that can be readily updated as new information becomes available. District staff will be able to use the GIS database as a tool to evaluate each potential acquisition based on characteristics such as location, existing natural and agricultural resources, proximity to protected lands, and potential risk of loss. This information will be considered with other acquisition and transactional criteria developed by the district in making a final decision on conservation priority projects.

Priority Mapping of Oak Woodlands

The acquisition plan's natural resources category seeks to conserve significant elements of Sonoma County's natural heritage, including oak woodlands, coast range forests, riparian corridors, and biodiversity (wetlands, threatened and endangered species, and areas of high vertebrate richness), and also seeks to acquire conservation easements or purchase land outright in areas of highest natural resource value.

We used the following criteria and mapping process to prioritize oak woodlands. All hardwood-dominated communities were first identified from the California Department of Forestry and Fire Protection (CDF) vegetation map, which is based on 1990 satellite imagery with 100-foot by 100-foot (approximately 30-m by 30-m) resolution. Hardwoods in coastal forests were then removed in order to identify and prioritize *Quercus*-dominated communities in the interior portions of the county. These inland oak woodlands were then prioritized by selecting contiguous stands of oaks that were deemed strategically important based on their size, habitat quality, and location within the county boundaries. All core oak woodlands included in the oak woodland priority map were below 1,700 feet (518 m) in elevation since these were considered most susceptible to development. In the Laguna de Santa Rosa, all hardwoods mapped by CDF and found on aerial photographs were used to identify remaining valley oak trees, which were also included on the oak woodland priority map.

What This Plan Will Do for Oak Woodland Conservation

Acquisition Plan 2000 has important implications for conserving oak woodlands in Sonoma County, where 90 percent of lands are in private ownership. Oak woodland habitats are estimated to cover approximately 20 percent of the landscape and are at risk from residential development, agricultural conversion, clearing for firewood, poor regeneration, and disease. Some types of oak woodlands face greater threats than others, such as oaks located on lower-elevation slopes and valley bottoms where development pressures continue to increase.

Biologists and planners concerned with preserving oak woodland biodiversity realize that successful conservation efforts must consider privately held lands and incentives to private landowners.

Acquisition Plan 2000 includes the following objectives for oak woodland conservation:

- Allocate acquisition funds for acquiring large stands of contiguous oak woodland, especially those located on lower-elevation slopes at greatest risk for conversion.
- Proactively seek willing sellers of properties ranked high priority for natural resources, including oak woodlands.
- Work with conservation partners to acquire large contiguous parcels and connecting corridors in the areas mapped as priority oak woodland.
- Acquire and preserve land for valley oak conservation and restoration in the Santa Rosa Plain, Laguna de Santa Rosa, and other areas of the county.

- Preserve properties that contribute significantly to maintaining the scenic qualities of oak-dominated hillsides.
- Provide a financial incentive for landowners to conserve oak woodlands.
- Augment existing and future regulatory and educational efforts.

To order a copy of Acquisition Plan 2000, or for additional information about the district's land conservation program, contact Sonoma County Agricultural Preservation and Open Space District, 747 Mendocino Avenue, #100, Santa Rosa, CA 95401, (707) 524-7360.

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Chapter 8

Oak and Oak Woodland Ordinances

Ted Swiecki and Douglas D. McCreary

Why Are Ordinances Used?

Since the early 1900s, when the courts upheld the authority of local governments to pass zoning laws, the use of ordinances has been extended to virtually every aspect of land-use regulation. More recently, ordinances have been applied to the protection of plants and animals and to regulate the effects of development on the natural environment. Local ordinances that regulate activities that affect individual trees or groups of trees are commonly referred to as "tree ordinances." Most California cities and many counties have tree ordinances of one sort or another. Many community tree ordinances focus on trees on public lands and those in the public right-of-way, especially street trees. However, starting in about the 1970s, an increasing number of community tree ordinances have included provisions that address trees on private property beyond the public right-of-way. Native trees, such as California oak species, are commonly the focus of ordinances intended to protect trees on private lands. A survey of cities and counties in California revealed that more than 100 local governments have some type of ordinance affecting native oaks (Bernhardt and Swiecki 1991).

Trees are often singled out for special protection relative to other vegetation because mature trees constitute a significant community resource. Trees and woodlands provide a wide variety of social and ecological services and benefits, such as aesthetics, recreational sites, soil stabilization, moderation of storm water flows, and wildlife habitat. For long-lived trees such as oaks, community benefits provided by individual trees and stands can last for generations. Although a mature tree and the long-term benefits it provides can be eliminated in as little as a few minutes, the values provided by a mature tree cannot be replaced in less than the amount of time required to grow a tree to mature size. Thus, the loss of trees and woodlands can have significant negative long-term impacts on communities and regions. Consequently, local governments have an interest in the conservation and sustainable management of these resources, whether they are located on private or public land.

Although many landowners manage oaks or other trees on their properties in a way that is beneficial to their own interests and the community as a whole, many others do not. Why doesn't everyone do the "right thing" on his or her own? Analysis of almost any situation will show that one or more of the following factors underlie management decisions that are detrimental to oak resources.

Lack of knowledge. Some landowners, especially those new to an area, may not have a full understanding of how to manage or protect their trees. For instance, many landowners have unwittingly damaged the roots of trees they hoped to maintain around a new home site, leading to premature death of desirable trees. Or, they may be largely unaware of the many benefits provided by trees and woodlands, such as their role in stabilizing soils, and so may not take those benefits into consideration before clearing trees.

Economics. Landowners may be unable or unwilling to spend the money necessary to manage individual trees or woodlands in a sustainable fashion. For example, developers may use site plans or construction techniques that are detrimental to long-term oak health and survival because they assume that most buyers will not be aware of the issues involved and would therefore be unwilling to pay a premium for efforts that protect trees.

Value system. People differ in the amount of value that they assign to different elements in their environment, irrespective of knowledge or economics. Individual preferences for property use or appearance may not coincide with what would be most beneficial to the community as a whole or the resource in question. Hence, a landowner's preference for a particular view may be greater than their appreciation of a tree that blocks it. A landowner who wants to grow grapes may see a woodland as merely a hindrance to their desired land use.

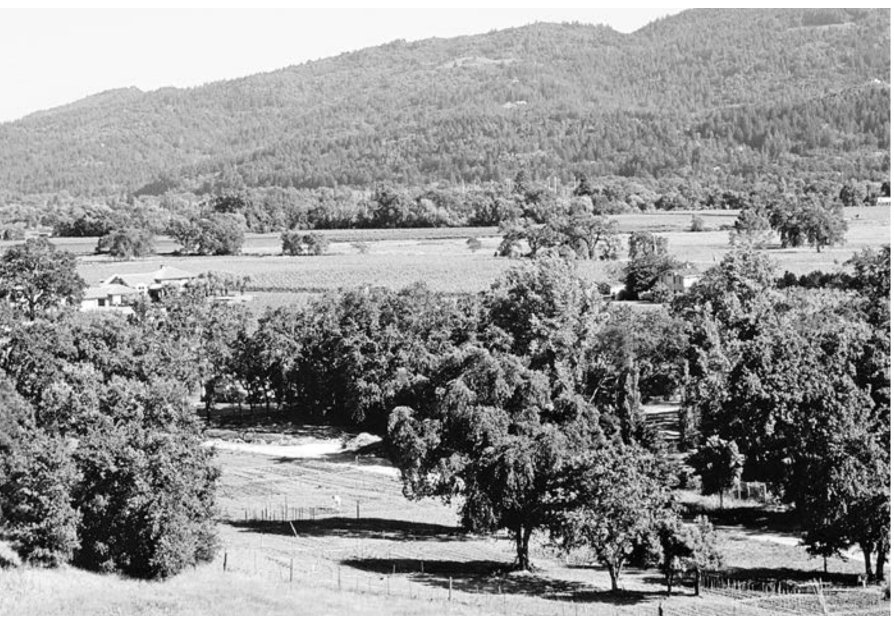
Ordinances can address all of these underlying causes of unsustainable oak management. An ordinance can establish outreach and educational programs and mandate professional standards to help minimize the amount of damage that results from ignorance alone. Ordinances can also establish financial incentives or disincentives that may tip the economic balance in favor of sustainable management. Finally, ordinances can simply prohibit management actions that may be driven by different values. However, this last tactic is generally the most likely to generate conflict in a community. Unless an ordinance that uses a strictly regulatory approach has been designed very carefully and enjoys widespread support in the community, it may not be very successful at accomplishing its objectives.

Tree Protection versus Woodland Conservation Ordinances

Tree ordinances may regulate many activities related to trees in urban, and less commonly, rural areas. Ordinances that seek to protect individual trees or groups of trees on private land are commonly referred to as tree-protection ordinances. Tree-protection ordinances can be further subdivided into two distinct categories, heritage-tree or landmark-tree ordinances and woodland-conservation or forest-conservation ordinances. Both types of tree-protection ordinances, and the many related issues surrounding them, are discussed in detail at the International Society or Arboriculture's Tree Ordinance Guidelines Web site, http://www.isa-arbor.com/tree-ord.

Heritage-tree Ordinances

Heritage-tree ordinances are the more common type of tree-protection ordinance and have been in wide use for several decades. These ordinances are best suited for protecting conspicuous (and typically large) individual trees that have unique historical, ecological, or aesthetic value. Heritage trees represent a resource that is essentially irreplaceable. No number of saplings can replace the historic, aesthetic, and ecological values provided by a massive 200-year-old oak. Heritage-tree ordinances therefore seek to limit indiscriminate removal of significant trees on private property by requiring a permit to remove them. In some municipalities, permits or notification are required to perform any operation that could injure a protected heritage tree, including pruning.



Some jurisdictions have attempted to use the heritage-tree ordinance model to protect oak woodlands. Although heritage-tree ordinances can be a useful tool for protecting individual trees in some situations, they are poorly suited to the conservation of oak woodlands for the following reasons.

Classes of trees covered

Most heritage-tree ordinances cover only large, mature trees. Oaks in smaller size classes, which constitute the next generation of trees, are usually ignored and, as a result, may be destroyed. In some jurisdictions, protection is extended to relatively small-diameter oaks. Even in these cases, however, small oak saplings, which may be decades old, are not normally covered. Furthermore, as the size class of nominally protected oaks decreases, it becomes progressively harder to monitor and enforce the ordinance. In some situations, such ordinances have motivated landowners to remove trees before they grow to the size covered by the ordinance.

Situations where the ordinance applies

Many heritage-tree ordinances apply only during urban development or other construction that requires a building permit. No protection is extended prior to or following development, and conversion of woodlands to intensive agriculture may not be subject to regulation. This may actually provide an incentive to remove trees in advance of any possible development to avoid the requirements that would come into play later. In some jurisdictions, restrictions apply to all parcels, whether they are being developed or not. However, the issue of monitoring and enforcing the ordinance on private properties that are not being developed is very difficult to address.

Lack of suitable performance requirements

Many heritage-tree ordinances, especially those that include small-diameter trees, do not prevent tree removal. Typically, they simply establish a complicated process that must be followed prior to removal and may require some sort of mitigation. Most ordinances stipulate that oaks may be removed if various criteria are met, and the proposed locations of buildings often take priority over oak trees. Even when replanting is required as mitigation for tree removal, these ordinances often call for the planting of a few large specimen-sized oaks, rather than woodland restoration. Also, they often do not have adequate monitoring to ensure that the oaks that are planted survive.

Tree-oriented, not woodland-oriented

Heritage-tree ordinances focus on individual trees, not stands or patches of woodland. They typically do not address the fragmentation of woodland habitat that occurs when areas are developed. Furthermore, by focusing only upon the oaks, these ordinances provide no protection for other components of the oak woodland ecosystem. Understory vegetation, dead trees, downed wood, natural topographic features, and other factors that contribute to the habitat value of the oak woodland are not afforded protection.

Sustainability usually not addressed

Although individual oaks can be long-lived, the life spans of oaks are still limited, especially in urbanized environments. By focusing on big, old trees, many heritage tree ordinances tend to create "museum" stands of declining trees, rather than striving to foster natural regeneration and the development of mixed-age stands. Hence, heritage-tree ordinances generally do not address the long-term sustainability of the oak woodlands very effectively.

Woodland or Forest Conservation Ordinances

Because heritage-tree ordinances by their nature focus on individual trees, they tend to be cumbersome when dealing with stands of trees and are generally not appropriate or effective for protecting woodlands and forests. In many cases, protection of oak woodlands can be achieved more effectively by ordinances that address the functional processes in oak woodlands, rather than individual oaks. There are few good examples of this type of ordinance that are currently in use in California. At minimum, ordinances aimed at the conservation of oak woodlands require that

- natural stands or groups of trees be given priority over individual specimens
- activities that fragment the woodland into small units be minimized
- meaningful standards for tree retention and reforestation be set
- provisions be made for natural regeneration of the woodland
- components of the woodland other than oaks be taken into account

Three basic approaches can be used in developing oak woodland conservation ordinances. Ordinances may use one approach or a combination of approaches to identify what areas should be subject to conservation and reforestation or afforestation standards.

Existing oak woodlands. In the first approach, only lands with existing oak woodland or forest resources are subject to the ordinance. This approach is most applicable in areas where current oak woodland cover is at or near historical or potential levels. To encourage good resource stewardship prior to development and to eliminate any advantage associated with preemptive resource removal, historical aerial photos can be used to establish the oak woodland resource baseline. Under this scenario, landowners would protect their future options best by maintaining as much woodland as possible.

Potential oak woodlands. In the second approach, regulated lands include all those that have current forest cover, as well as those that historically supported forests or woodlands. This approach is especially applicable in areas where current tree cover is well below former levels and the community has the goal of restoring lost or degraded woodlands. This approach allows for conservation of existing resources and restoration of lost or degraded resources, while taking into account the different capabilities of lands to support forest cover. The use of current forest baseline data and minimum afforestation standards discourages landowners from clearing lands prior to initiating the development process.

Universal application. In the third approach, regulations apply to all lands irrespective of current forest cover. In the Maryland Forest Conservation Act, all landowners seeking to intensify land use on nonurbanized lands are responsible for a given level of woodland or forest canopy whether or not their lands are currently forested. This approach is appropriate in areas where forest canopy cover was historically fairly uniform before being cleared as part of forest operations, agricultural use, or urban development. Minimum afforestation standards included in this approach can provide a disincentive to clear land prior to development.

Regardless of the approach used, existing forests and woodlands should generally be subject to higher conservation standards than potential forest land because existing forests generally have much greater ecological value than a newly planted stand. Other key components of a woodland conservation ordinance include

- activities regulated on lands covered with woodlands or forests
- criteria and standards for approving regulated activities, including mitigation requirements
- permit process, including requirements, fees, time limits, and appeals
- provisions for monitoring compliance

Activities regulated through the permit process should include all those that directly affect oak trees, including removal, cutting, and disturbance of oak roots. In addition, activities that affect other significant woodland resources, including understory vegetation, soils, and watercourses, should also be controlled. These activities might include grading, tilling, burning, application of chemicals, or any other activity that significantly alters the existing woodland habitat.

The ordinance should set performance standards to limit the amount of woodland removal or disturbance that will be allowed. Standards for oak retention and reforestation will vary with the types of woodlands involved, but standards could be expressed in terms of percent canopy cover or stocking rates (trees per unit area). Development of any kind generally results in greater canopy loss in areas with high levels of canopy cover than in areas with low levels of canopy cover. Therefore, it may be desirable to establish different standards for canopy retention based on the baseline level of canopy.

Developing an Effective Oak Ordinance

Many tree ordinances have been developed by copying code from other jurisdictions, borrowing existing language and documents as models, often without regard to unique local conditions and circumstances. Besides stifling innovation, there are several other problems with this approach:

- Important biological, economic and social elements may not be considered in this process.
- Provisions are often selected without any information about effectiveness.
- Ordinances are adopted that have no relationship to integrated management strategies.

- The ordinance is often seen as an end in itself, rather than one means to promote oak conservation and stewardship.

In many communities, interest in developing an oak protection ordinance of some sort is triggered by a specific incident such as the cutting down of a large, revered tree or the clearing of an area of land for houses or agriculture. The resulting public outcry to "do something" may lead to the hasty adoption of regulations that are not consistent with sound management, and may even foster poor management.

It is important to keep in mind that ordinances are simply one tool that may be used to implement a comprehensive resource management program, and that the primary goal of any ordinance should be management, not regulation. The *Guidelines for Developing and Evaluating Tree Ordinances* (Bernhardt and Swiecki 1991; see also Bernhardt and Swiecki 2001) presents a complete process for developing tree ordinances as part of an overall management strategy by following the adaptive management process. Using this process, a community can explore options other than ordinances that may be part of an overall program for protecting and managing oak woodlands.

Tree ordinances are commonly only part of a comprehensive oak resource management scheme. Ordinances provide the legal framework for the management program by enabling and authorizing various activities related to oak stewardship on both public and private properties. However, it is important that ordinances facilitate, rather than prescribe, management. Ordinances are generally too coarse and static to serve as the final blueprint for managing complex ecological systems like oak woodlands. Because methods for managing oak woodland ecosystems are continually evolving, it is critical that ordinances facilitate the input of trained professionals into the management process.

Features of a Successful Ordinance

Despite considerable variability in form, content, and complexity among tree ordinances, effective ones generally share similar basic features. Although having these features does not guarantee that an ordinance will be effective, ordinances lacking one or more of these features will probably not accomplish the overall objective of conserving oak woodland resources. These key features are listed below.

1. Protecting oaks enjoys a high degree of citizen support.

Citizen support cannot be legislated into an ordinance. Rather, an oak ordinance must be developed in the context of an informed and supportive citizenry. Most tree ordinances rely heavily on voluntary compliance and reporting of violations by members of the community. Relatively few communities would support the concept of a roving "tree cop" that seeks out violations, but citizens in many areas are willing to report obvious violations to protect their local oak resources. In counties where citizens strongly support the protection and enhancement of oak resources, even highly restrictive ordinances can be effective. For example, the city of Thousand Oaks takes a yearly community attitude survey, the results of which show that oak tree preservation ranks among the top ten community values. This level of community support may make certain regulations viable in this community that would not be possible elsewhere.

2. The ordinance is part of an overall management strategy.

An ordinance should be considered only in the context of a more comprehensive plan for managing oak resources. Without the broader view of a comprehensive management strategy, an ordinance may inadvertently permit the continued degradation of the woodland community as a whole, even though individual trees are protected.

3. The goals of the ordinance are clearly stated.

A clear statement of goals in the ordinance is critical. The goals should be specific so that clear relationships between the goals and actual ordinance provisions can be established. Specific goals can be objectively evaluated to determine whether the ordinance is having its desired effect. More general goals, such as to "prevent wanton destruction of oak trees," are not easily implemented and do not lend themselves to an objective evaluation.

4. Responsibility and authority are clearly designated.

The management actions authorized in an ordinance do not happen by themselves. Permit applications need to be reviewed and acted on, standards must be enforced, and educational and incentive programs need to be administered and implemented. It is generally more efficient if a single position is charged with the responsibility of overseeing and coordinating all oak-related activities. The effectiveness of an ordinance tends to suffer when the responsibility for implementation is split between many different positions. Whenever responsibility is assigned, authority must also be granted. If the responsibility to conduct various activities exceeds the authority necessary to make them happen, those charged with implementation are likely to become frustrated, and the ordinance is unlikely to fulfill its goals. Examples of oak ordinance administration include the following:

- Sacramento County has a tree coordinator.
- Sonoma and Santa Cruz Counties give tree permit authority to the planning director.
- Monterey County gives oak-cutting permit authority to planning commissioners.
- The Los Angeles County forester and fire warden issue cutting permits.

Discussions with staff from other cities and counties may help clarify which administrative structure would be most appropriate and effective in a given situation.

5. The ordinance establishes basic performance standards.

An ordinance should set standards that indicate what is acceptable and what is not. Very few existing oak ordinances set basic performance standards or set limits for the maximum amount of depletion or destruction of oak woodlands that can be accepted. For instance, many oak ordinances require an extensive permitting process before oaks can be removed, but few set standards for the maximum amount of canopy that can be removed overall, or the minimum canopy that must be retained to maintain important ecological relationships. If basic performance standards are not set, it is possible that all individual actions taken will conform with the ordinance, but the overall goals of the ordinance will not be achieved. These standards will vary between jurisdictions due to the differences in ecological constraints (e.g., oak species, climate, wildlife habitat needs) and patterns of land use. Examples of specific performance standards include the following:

- Riverside County will permit construction in certain zones if 30 percent of trees are left and half of the area is visible from the road.
- Monterey County will allow cutting up to 25 percent of the canopy without a permit if recommended best management practices for regeneration are used; in some areas a forest management plan by a registered professional forester is required to cut more than 3 trees per lot per year.
- The Maryland Forest Conservation Act and local ordinances based on it establish standards for retention of existing forests and for the afforestation or reforestation of lands in connection with development and certain other land-use changes.

6. Flexibility is built into the ordinance.

While ordinances should set basic performance standards, it is important that their implementation permits input from qualified professionals. Unfortunately, many ordinances tend to take a "cookbook" approach to oak resource management. Instead of setting basic performance standards, ordinances often focus on detailed implementation standards. For example, some ordinances specify the size of planting stock to be used in replacement plantings. Instead, this decision should be based on plant and site characteristics and is best left up to qualified professionals who have reviewed the relevant information and assessed the planting site. Rather than locking in a specific type of planting material, the ordinance may be better served by requiring that a replacement value, such as a certain basal area of trees 4 years after planting, be required. The county's oak specialist would then have the flexibility to decide how to best design projects to restock targeted areas.

If detailed implementation standards need to be specified, they should be listed in accompanying regulations rather than in the ordinance itself. The local government's oak specialist can then modify these regulations as appropriate. As new information becomes available, old methods and materials may become obsolete. By leaving the formulation of detailed standards up to qualified specialists, the city or county can ensure that oak management practices mandated by an ordinance are kept up to date and are appropriate to each particular site.

7. Enforcement methods are specified.

No matter how well conceived and written an ordinance is, it is unlikely to accomplish much if it is not enforced. To be effective, oak ordinances need to assign enforcement responsibility and authority, as well as to specify penalties for violations. A variety of penalties may be used, including fines, jail terms, forfeiture of performance bonds, replacement planting requirements, and the withholding of permit approval. Penalties may help deter potential offenders, but only if consistent enforcement makes it likely that violators will be cited and penalized. Examples of enforcement penalties include the following:

- San Diego County's brushing ordinance can levy fines of $1,000 per day and deny property-use permits for up to 5 years if a site, which has been cleared purportedly for agriculture, is converted to nonagricultural use.
- San Bernardino County has penalties of $500 to $1,000 or 6 months in jail for ordinance violations.
- Santa Cruz County has fines up to $5,000 for violations.

Balancing Regulations and Incentives

It is worth reiterating that ordinances that regulate natural resources on private lands are unlikely to be effective without community support. Unless residents understand the importance of oak woodlands and support conservation efforts, the local government will have a difficult time obtaining compliance. Whenever possible, it is advisable to link oak protection requirements with some sort of benefit or incentive to balance the additional burden imposed. A variety of options are available, such as

- providing tree-care assistance or consulting
- reducing certain assessments or providing financial aid for tree and woodland management costs
- instituting a recognition program to provide a tangible benefit to owners of protected private trees or woodlands

Education and incentive programs are also needed to ensure that oaks and oak woodlands are seen as an asset rather than a liability. These programs can be established through language included in the ordinance itself. Educational programs that focus on oak values can be an effective method of generating local support. These programs can discuss such topics as wildlife values, aesthetic values (e.g., shade, noise abatement, and dust filtration), and property values. Local support for these programs can be sought through the University of California Cooperative Extension, the California Department of Fish and Game, community colleges, environmental groups, and local consultants. Education can help establish a healthy balance between regulation and incentives, making it easier to obtain consensus about the ordinance within the community.

Conclusions

An ordinance is not a panacea for poor or inadequate management of oak resources. Properly applied, an ordinance can facilitate good management. Improperly applied, ordinances can legitimize counterproductive practices, provide disincentives for oak conservation, and undermine the long-term sustainability of local oak woodlands. By focusing on overall management of local oak resources, local governments can determine whether an ordinance is necessary and what its role should be. By following the process outlined above, jurisdictions can develop ordinances that are uniquely suited to meet their specific needs. Finally, by providing for regular evaluation and revision, local governments can ensure that management plans and processes are modified and updated as needed to meet changing needs.

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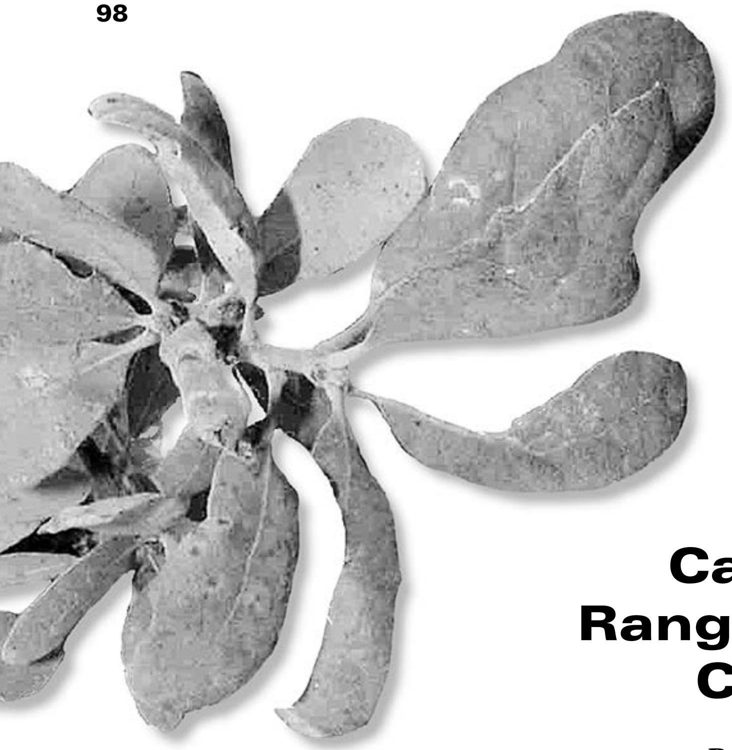

Chapter 9

California's Hardwood Rangelands: Production and Conservation Values

Richard B. Standiford and Sheila Barry

California's 10 million acres (4 million ha) of hardwood rangelands, or oak woodlands, are the most biologically diverse and widespread habitat in the state. Most of the state's water supply flows through these lands. They also supply aesthetics and recreational opportunities. However, private landowners, who own over 80 percent of the state's hardwood rangelands, mainly supply these important public values. Over two-thirds of all hardwood rangelands are grazed by domestic livestock.

The continued supply of public values from these private lands depends in large measure on the economic value of these lands and the opportunity costs of competing land uses, such as urban developments, intensive agricultural enterprises, and rural ranchettes. Economic institutions such as conservation easements and property tax policies (including the Williamson Act) provide opportunities for private owners to benefit from the amenity values supplied by their lands. Broadened markets for products from hardwood rangelands, including fee hunting and recreational leasing, also increase returns and help maintain extensively managed private rangelands. Several of the factors affecting the economic value of hardwood rangeland values are discussed below.

Factors Influencing Grazing Land Value

A variety of economic, site productivity, and management factors influence the value of hardwood rangelands for grazing enterprises. These include

- livestock prices
- management practices
- rangeland productivity
- improvements (fences, water sources)
- forage quality
- other products or services produced (hunt clubs, recreation, firewood)
- risk and variability
- access to other feed sources

- opportunity costs (alternative land uses such as urban developments, intensive agriculture)

Figure 9.1 shows the tremendous variability in real livestock prices, ignoring the effects of inflation. Similar variations in hay prices also exist. In addition to these economic fluctuations, forage production varies annually as a result in annual rain and temperature variation (see fig. 9.2). These factors create large annual variation in returns. An individual owner's capacity to respond to risk depends on borrowed capital, management strategies, and general financial standing.

Research on grazing land value has been carried out by the University of California Integrated Hardwood Range Management Program (IHRMP). These studies have evaluated how general rangeland site productivity, types of enterprises (such as livestock and hunt clubs), and risk affect land value and annual lease value. Table 9.1 and figure 9.3 show the results of this research.

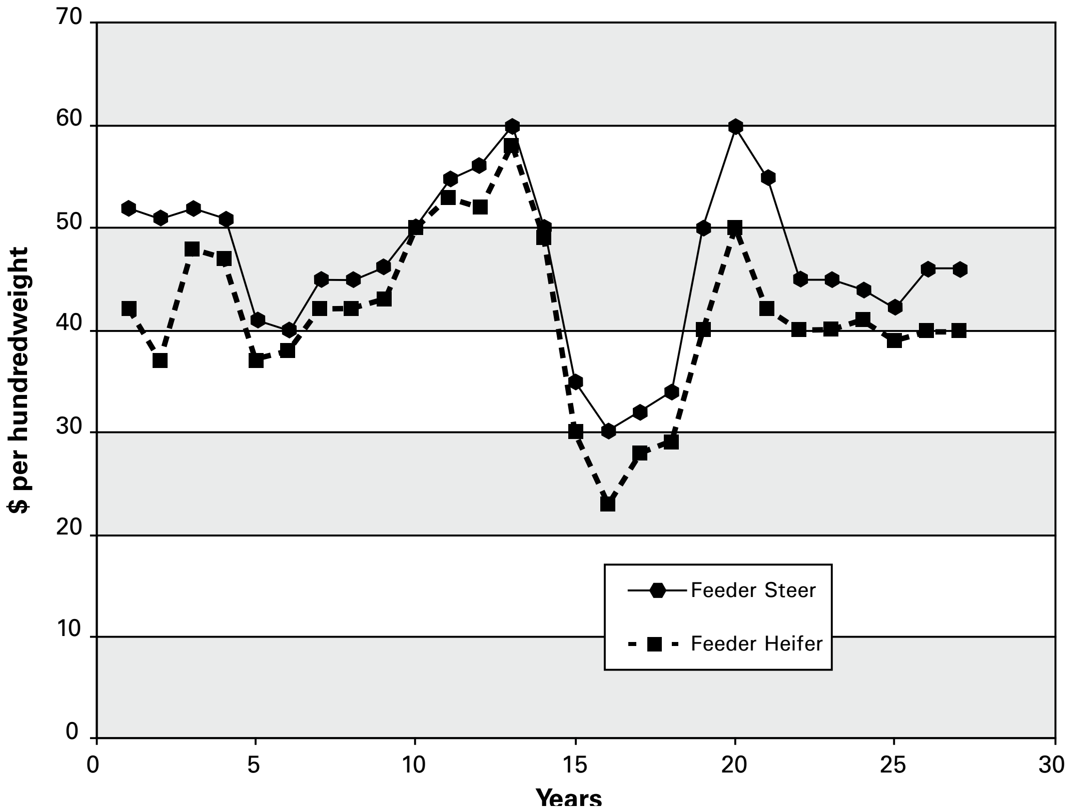

Figure 9.1. Real cattle price in California (ignoring inflation) variability over 26 years. *Source:* Standiford and Howitt 1993.

Opportunity Costs of Hardwood Rangelands

In many areas of the state, grazing and hunting values represent only a small fraction of the actual land value. There are a wide variety of alternative land uses on hardwood rangelands. In some areas of the state, rangeland soils have potential for intensive agricultural products, such as wine grape production. Land-use planning policies in many hardwood rangeland areas permit subdivision of large parcels into small-scale ranchettes of 5 to 40 acres (2 to 16 ha). Urban developments are also occurring in many areas. These alternative land uses often have much higher market values than the extensively managed grazing land, which has so effectively conserved many of the amenity and conservation values. Many of these higher-value land uses, unless carefully planned, fragment hardwood rangeland habitats and diminish their capacity to supply many of the amenity values that have historically existed. These alternative land uses create an opportunity cost for owners. For example, in the Central Coast of California, data on land values show that grazing land may be worth less than 10 percent of the value of the land for wine grapes, or less than 1 percent of its value for residential uses. This creates tremendous pressure to convert hardwood rangelands to land uses that may cause higher environmental costs. Figure 9.4 compares grazing land value to land with potential for wine-grape development.

Table 9.1. Land and lease value of selected rangeland enterprises

Enterprise	Risk*	Good range site (1.3–2 AUMs† per acre)		Poor range site (0.4 to 0.7 AUMs per acre)	
		Land value ($/ac)	Lease value ($/ac/yr)	Land value ($/ac)	Lease value ($/ac/yr)
livestock grazing	no risk	$375	$15	$125	$5
	with risk	$325	$13	$100	$4
grazing and hunt club	no risk	$550	$22	$270	$11
	with risk	$500	$20	$170	$7

Notes:
*Risk factor evaluated is a 1 in 10 chance of losing money.
†AUM = animal unit month, the amount of feed needed to support a cow and a calf for one month.

Values and Markets for Amenities

Land markets for hardwood rangelands are beginning to recognize the amenity values they supply. Research has shown, for example, that oak stands contribute significantly to overall property value. The oaks on the property, the presence of oaks in a neighborhood, and the presence of hardwood rangeland open space adjacent to a property have been demonstrated to affect property values. For privately owned rangeland, this shows that the economic value of large blocks of oak woodland may contribute to not only the value of the specific property but to the overall value of an entire community.

To determine the value of oak stands to land values, research was done on different spatial arrangements of oak stands and how this contributed to overall property value. On 5-acre (2-ha) lots, rangeland with at least 40 oaks per acre (33-foot [10-m] spacing or less) was worth 27 percent more than open land. There was a similar value for open- to heavy-tree stocking (40 to 460 trees per acre [98 to 1,136 per ha]) on these 5-acre lots (see fig. 9.5). Similar trends were also observed on 2-acre (0.8-ha) lots, with 40 trees per acre being worth 22 percent more than bare land. Denser areas (over 40 trees per acre) were not worth as much as the more-open stands, but they still had higher value than bare land.

The effect of an 8,300-acre (3,360-ha) oak woodland open space in Southern California on overall community land and home value was also evaluated. The distance of homes and land parcels to the open space land and to the nearest stand of native oak stands was positively related to land and home prices. Figures 9.6 and 9.7 show how an individual home or land parcel value was affected by the presence of adjacent oak stands and open space land. The average home in the study area was 885 feet (270 m) from a native oak stand. For the same general housing characteristics, if native oak stands were immediately adjacent to an owner's house, the average home price in the study area was 12 percent higher (fig. 9.6). Undeveloped land immediately adjacent to the open space area was projected to be valued 17 percent higher than the same land characterisitics set 1,000 feet (305 m) from the edge of the open space area (fig. 9.7). Clearly, private landowners received a premium by being located adjacent to land that will remain as dedicated open space.

This research also showed that the oak stands and open space land had value to the overall community. A decrease of 10 percent in the distance to the nearest oak stands and to the edge of the permanent open space land resulted in an increase of $4 million in the total home value and an increase of $16 million in total land value in the community.

These results demonstrate that individual homeowners are willing to pay a premium if native oak stands are located near their residences. This type of study demonstrates the on-site and off-site benefits of open space areas and native oak woodland stands. Conservation of oak woodland open space increases overall land and home value of an entire community. The overall assessed property value of this particular community is higher because of the value added by these environmental assets, with the resulting increases in annual property tax accruing to local government. This can be used to justify public financing of local oak restoration efforts or for the purchase of development rights for permanent open space or extensively managed working landscapes. There is economic value for conservation of native habitats.

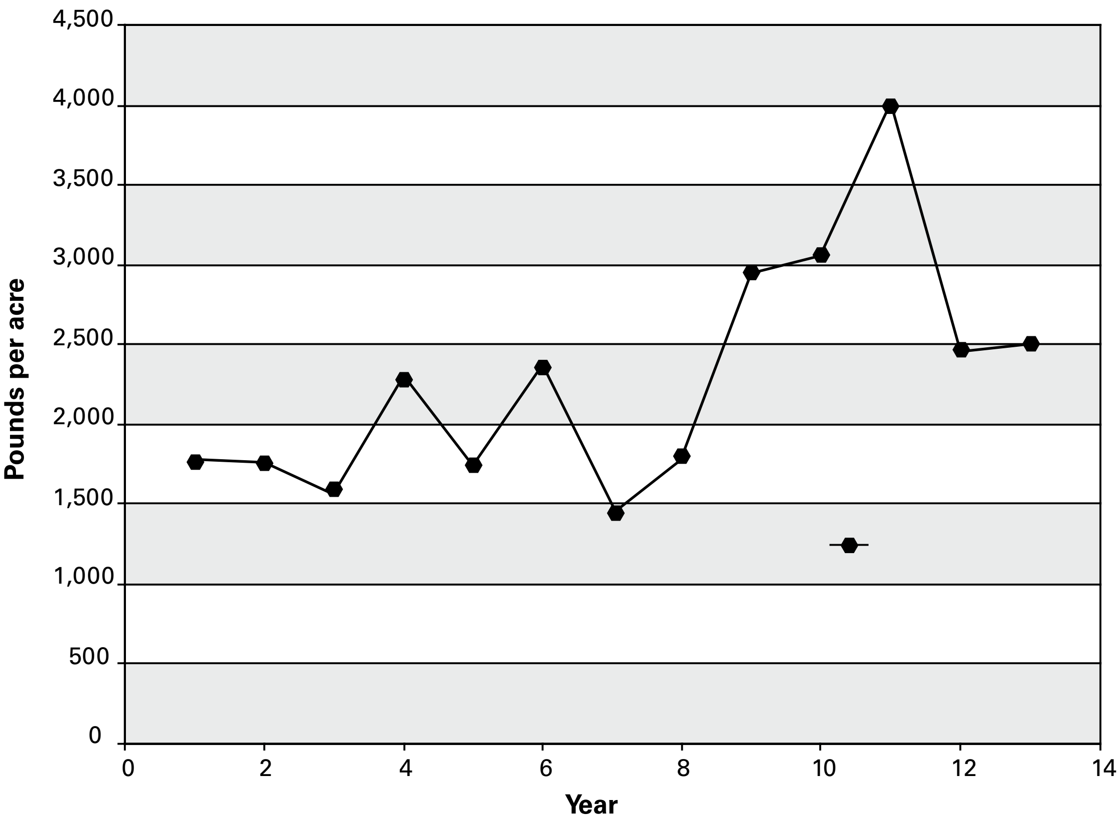

Figure 9.2. Typical variability in rangeland forage production. *Source:* Standiford and Howitt 1993.

Maintaining and Enhancing Property Value

Given the increasing value of hardwood rangelands, it is beneficial for landowners to maintain the health and vigor of trees. Owners should attempt to maintain stands of trees in areas that may be developed because of the higher value of these lots. Also, since forested neighborhoods have higher value, it may be wise for homeowner associations to use covenants, codes, and restrictions (CC&Rs) to maintain overall oak stands in a neighborhood. The effect of undeveloped open space on enhancing adjacent property values points to the role of compensation of large ownerships through land trusts because of the economic, as well as the conservation value, of these types of lands.

The returns from grazing and other types of extensive management is only a fraction of the oak woodland value. Land markets are beginning to recognize the amenity values of these areas. Outright compensation through the purchase of development rights, or tax and estate planning benefits through donation of the land value differences, can help provide economic incentives for landowners to maintain the conservation value of the lands they own.

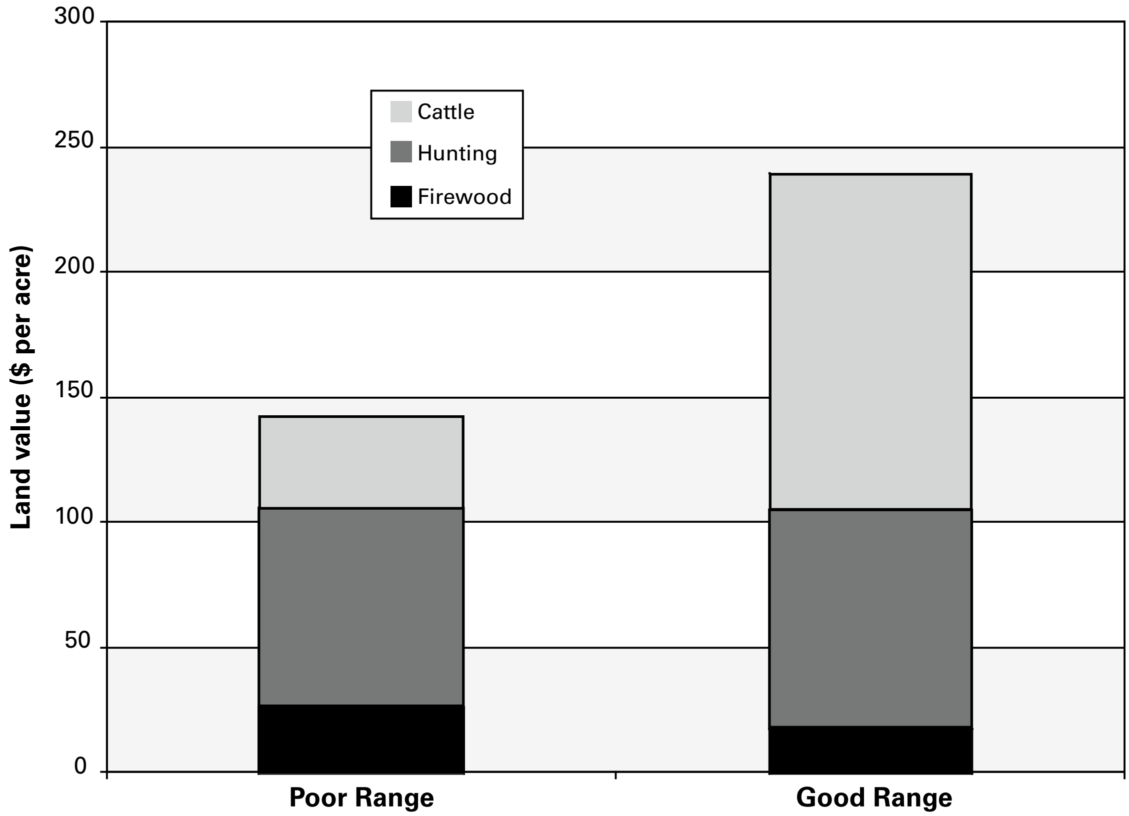

Figure 9.3. Contribution of various enterprises to hardwood rangeland value. *Source:* Standiford and Howitt 1993.

Maintaining Working Landscapes to Conserve Oak Woodlands

California's hardwood rangelands are among the most productive rangelands in the West. Composed of predominately Mediterranean annual grasses and forbs, these rangelands encompass all of the Central Valley, as well as the coastal and foothill ranges. Annual forage production in these regions is seasonal, but grazing of green or dry forage occurs year-round.

Since the establishment of the first Spanish mission in San Diego in the early 1700s, domestic livestock have been an important component of California's economic and social fabric. Many ranches still in operation today were established following the discovery of gold at Sutter's Mill in 1848 and have been in the same family for four or five generations.

Privately owned, grazed oak woodlands help maintain ecological integrity through watershed, wildlife, and open space values. Even though these ecological and social values are earning broader acknowledgment, these benefits often provide minimal economic returns to the landowner. The threat to develop these lands, or to convert them to high-value intensively produced commodities or subdivisions, continues to grow. For generations, private landowners of oak woodlands have faced threats to their land and livelihoods including wildfire, drought, floods, pests, and low market prices. These threats are exacerbated today by a suburbanizing landscape, estate taxes, and the cost of buying out family members who no longer want to participate in ranching. With land values for grazing being typically less than 20 percent of the price these lands would bring on the open market, the only economic justification for ranching is to hold land for increased real estate value.

Although monies to acquire oak woodlands for conservation purposes have been relatively plentiful in the last decade, it is generally accepted that extensive landscapes, like California's oak woodlands, may be conserved only if the private sector (ranching industry) is included. Land-use planning that aims to protect oak woodlands must consider hardwood rangelands and can only be a success as a result of cooperative efforts from planners, ranchers and conservationists. To better foster that relationship, planners can provide valuable assistance to landowners interested in maintaining an oak woodland landscape if they understand some of the planning issues that influence a rancher's decision to stay on the land.

Ranchers' Decision-making Process

The importance of a single ranchowner's decision should not be underestimated; their decision may seal the fate of many thousands of acres. Ranch properties are influenced by fragmentation of land use, weakening of the agricultural infrastructure, changing land values, and the creation of new growth nodes in previously undeveloped areas. Numerous studies note that "quality of life" values, and not just profits, strongly influence the decisions of ranchers. For example, the majority of California hardwood rangeland owners reported in a 1995 survey that "living near

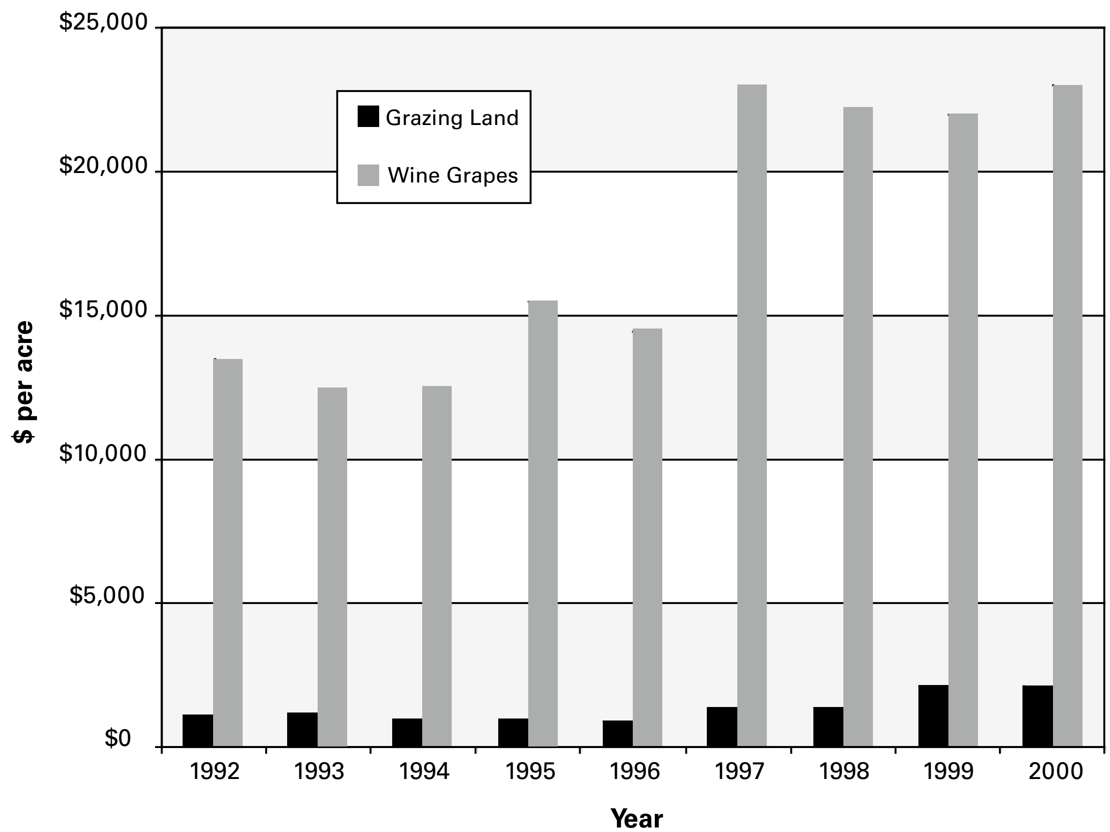

Figure 9.4. Typical value of Central Coast California hardwood rangelands for selected land uses. *Source:* CALASFMRA 2001.

natural beauty" was an important reason to ranch. Despite generally low profits in the livestock industry, this attitude is prevalent in ranchers throughout the western United States who continued to ranch for reasons described as "love of the land,"

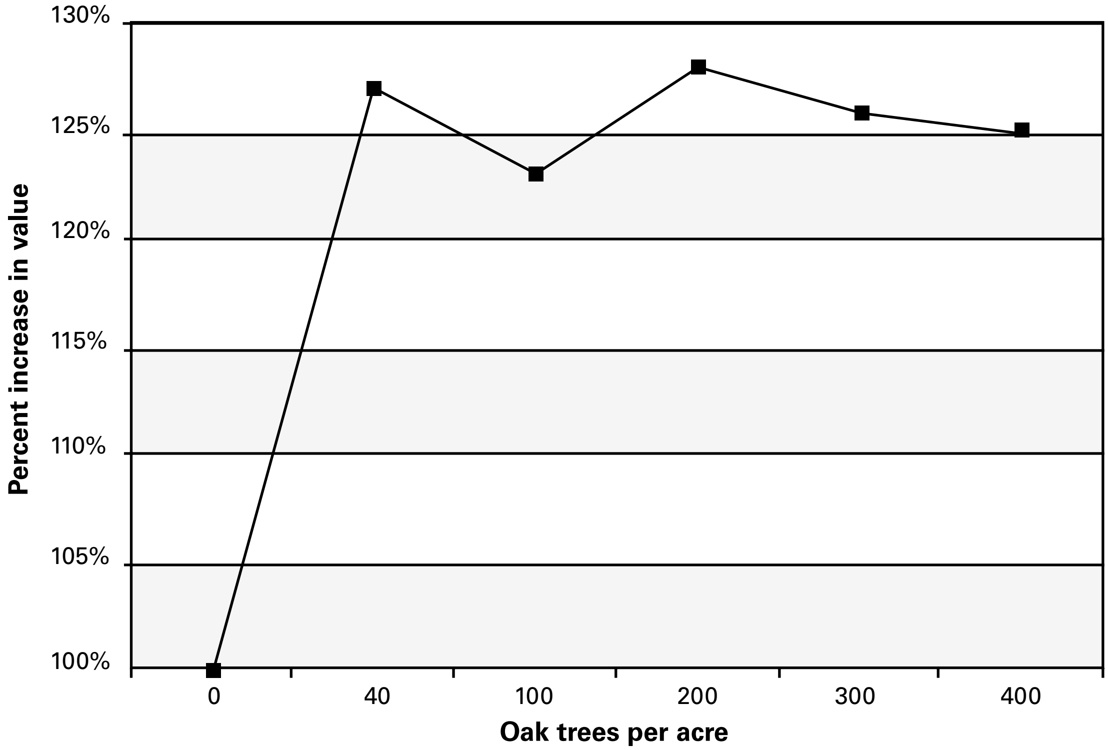

Figure 9.5. Effect of the number of oak trees per acre on property value in coastal California hardwood rangelands. *Source:* Diamond et al. 1987.

benefits to family life, and the independent ranching lifestyle.

Both profit and "quality of life" benefits are diminished as urban development advances into rangeland. Ranching on the urban interface becomes more expensive as ranchers must deal with stray dogs, vandalism, trespassing, the introduction of exotic plants, increased costs of maintaining fences and gates, and increased liability costs. Restrictions on traditional management activities such as controlled burning and pest control may also affect profitability. The loss of the "critical mass" of ranchers on the urban fringe can also impose additional costs on ranching operations, especially if there are not enough ranchers to maintain agricultural support services. For example, livestock auction yards, which provide the principal marketing outlet for most ranchers, require large volumes of activity in order to operate efficiently. If too many ranchers exit the livestock business, their departure will threaten the vitality of this important exchange mechanism.

Rising land speculation in an urbanizing area can also create a demoralizing effect, known as the "impermanence syndrome." This syndrome causes landowners who expect to sell out for nonagricultural uses in the future to postpone or limit ranch improvements and management activities, thereby further diminishing their ability or desire to remain viable.

Conflict at the urban interface not only impacts the ranchers with increased cost, it also results in an undesirable atmosphere for many ranchers as conflicts arise over odors, noise, stray livestock, human trespassing, vandalism, and pet predation. This new environment can often result in a contentious atmosphere that can lead to formal litigation between landowners or restriction of agricultural activities through county actions such as ordinances or zoning.

Historically, ranchers resolved neighbor disputes through peer relations and personal contacts. The influx of exurbanites that often have different, and litigious, ideas about how to resolve conflicts can create a stressful situation that ranchers are ill-prepared to address. For example, in a 1995 survey of ranchers in Tehama County, the majority of those surveyed said that if stray livestock wandered onto their property, they would either round up the animals and return them or call the owner and discuss the procedure for gathering and returning them. They wouldn't call any of the agencies or legal entities responsible for animal or livestock control. The survey supports the notion that ranchers have traditionally relied on the cooperation and participation of neighbors in rounding up herds, branding, and other challenges. They believe working collaboratively with neighbors has social and practical benefits that cement cohesive ranching communities. They perceive their newly established urbanite neighbors as not being able to tell whose stock is involved and not understanding a rancher's aversion to contacting the police or animal services to resolve such situations.

In this same 1995 survey, ranchers commonly cited reasons for quitting included "being over-regulated" and "society's hostility toward ranching." Once the social, economic, and ecological structures of the ranching community are fractured, it becomes a decisive element contributing to a rancher's decision to sell land for development.

Planning Considerations

The long-term viability of California's ranching community depends on ranchers' ability to generate a stream of revenue and to pass along their lands to future generations. For example, the rangeland being used for cattle production has

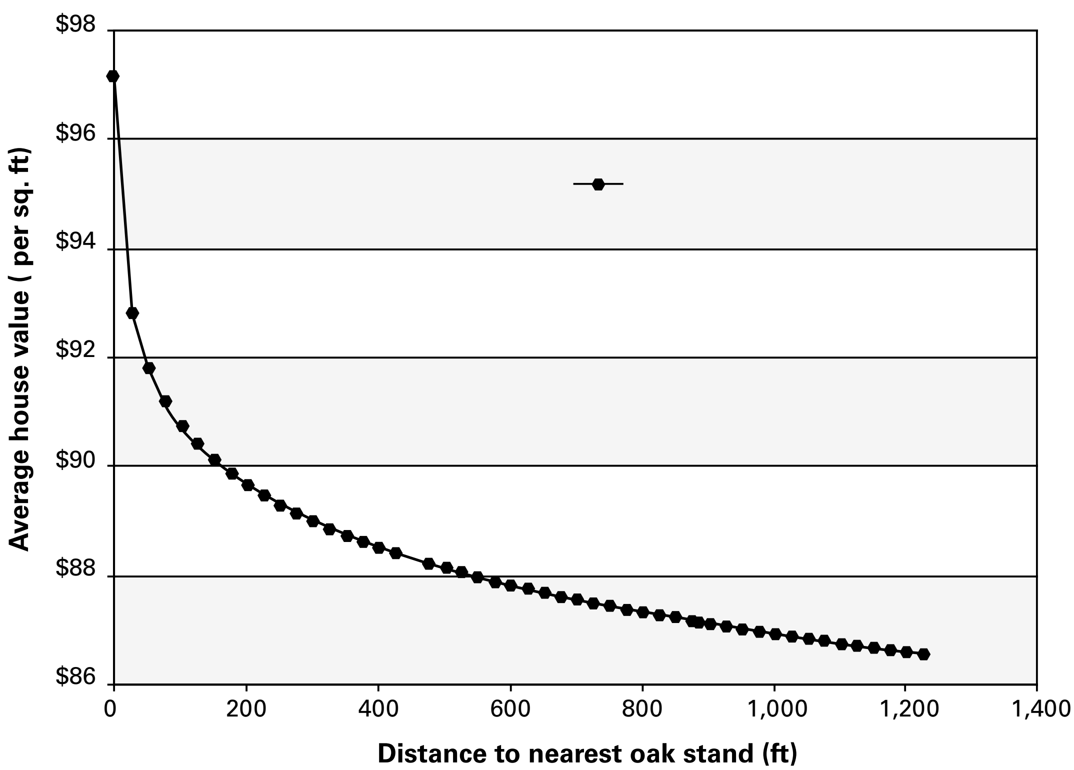

Figure 9.6. Effect of distance to nearest native oak stand on average house value in Southern California.
Source: Standiford and Scott 2001.

few alternative agricultural uses. Today's cattle industry is dominated by cow-calf ranching operations that rely on a significant percentage of cattle being exported out of the state for feeding and slaughter. Since feedlots and packing plants are not popular enterprises in a state like California, ranchers here are at a fiscal disadvantage with ranchers in neighboring states who have minimal transportation costs associated with cattle hauling.

Second, California's ranchers depend on their ability to transfer the land base from one generation to the next. A statewide survey revealed that the average length of experience in ranching was 34.9 years, suggesting that ranching is a lifetime avocation. As ranchers near retirement age, questions arise regarding the continuity of the operation and whether their children will choose to carry on the family business and be able to afford the estate taxes to hold the land base. Estate taxes have emerged as one of the most monumental threats to the lifestyles and estates of California hardwood rangeland owners.

Planners can take the following specific actions that affect ranching revenue streams and the ability of the ranch to pass on to the next generation.

Zoning

Zoning designations should be used to help direct appropriate land uses adjacent to ranching operations. Use permits should consider the juxtaposition of the proposed project or development relative to existing ranching operations to ensure compatible adjacency criteria are met. For example, proposed projects that require solitude, such as religious or recreational retreats, being proposed in areas designated as agricultural preserve zones should be examined critically to explain to the project proponents what is allowed in that zoning designation. Furthermore, zoning restrictions should aim to minimize fragmentation of large ownerships to retain relatively large parcel sizes that maintain working hardwood rangelands, that is, greater than 500 acres (200 ha), with the opportunity to cluster a relatively small number of residential parcels.

Urban buffer and implementation of right-to-farm laws

Conflicts inevitably arise between ranchers and adjacent nonranching landowners who may resent noises, smells, and loud machinery. Additionally, ranchers may suffer from vandalism and harassment of their livestock from dogs allowed to roam by neighbors. Planning options designed to separate urban and suburban areas from agriculture should not do so at agriculture's expense. Counties can promote harmonious landscapes by adopting right-to-farm ordinances and using the Williamson Act to inform prospective project developers about the consequences of locating in an agricultural area that is designed for commercial activities. Increasing general awareness of planning considerations aimed at protecting agriculture can recognize that farmers and ranchers operating in a legal and reasonable manner may receive protection from citizen complaints and lawsuits and can demonstrate the community's support for conserving agriculture.

Agricultural support services

Once subdivided, ranch communities begin to lose their vitality. Local farm services start leaving, forcing ranchers to spend more time and money traveling to distant farm service centers. Consequently, rising costs and cumulative difficulties drive ranchers off the land, resulting in the loss of customers and clients to farm supply centers. This, in turn, can make farm life even tougher for those struggling to remain. Examples include the potential closure of a livestock auction yard in favor of a factory outlet, mall, or subdivision. Planning efforts aimed at promoting and maintaining agriculture in their communities must recognize the need to retain agricultural support services.

Ranch infrastructure

A working rangeland landscape requires infrastructure, including roads, livestock facilities (corrals and livestock watering facilities, including stock ponds), and housing for ranch workers. Since most ranch operations in California are family-owned and operated, housing for workers may also need to include housing for senior family members. When addressing infrastructure needs for ranching operations, zoning and other planning considerations should recognize the family nature of the operation. Issues of compatibility that are important components of maintaining infrastructure include the construction of additional family living quarters and road maintenance considerations versus road construction restrictions. Developing planning language aimed at protecting agricultural infrastructure is an important consideration for ranching viability.

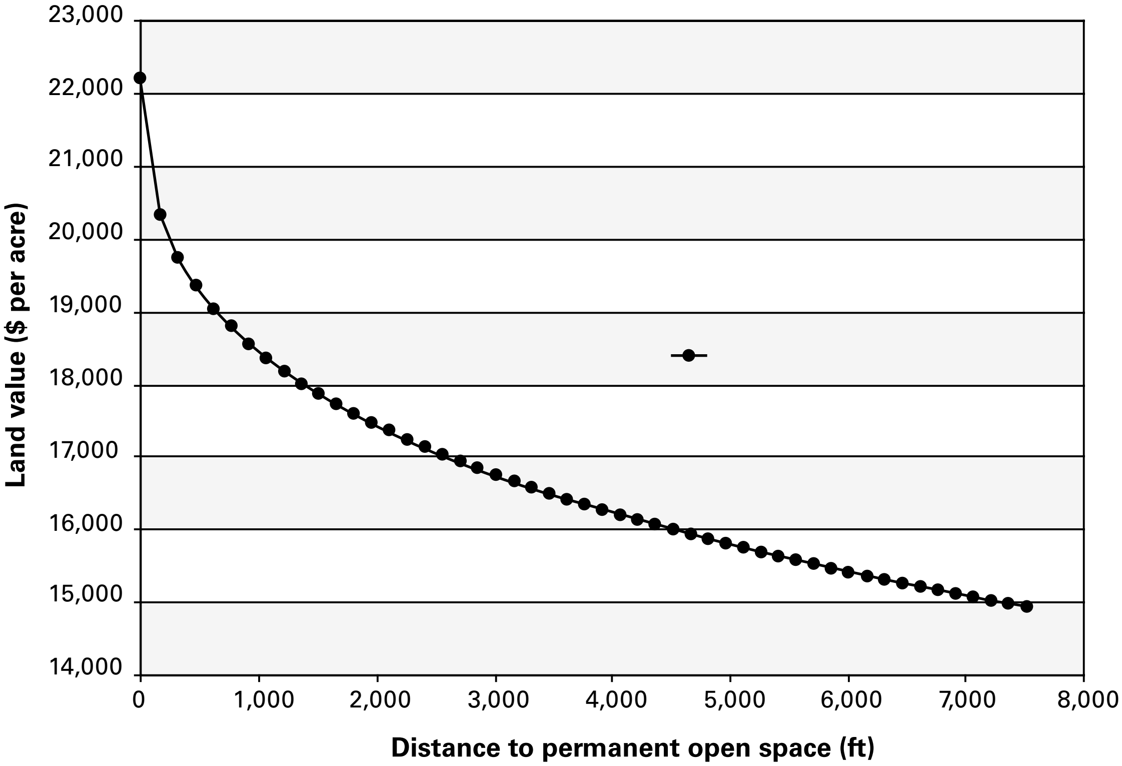

Figure 9.7. Effect of distance to dedicated oak woodland open space on land value in Southern California. *Source:* Standiford and Scott 2001.

Access and transportation corridors

Ranch equipment and livestock are often transported in large trucks and trailers. As urbanization changes the face of California's landscape, road design and layout should consider access to ranch properties with large vehicles. Development activities adjacent to these commercial routes should be evaluated based on their compatibility with heavy equipment use.

Opportunities for alternative income

As noted previously, ranch operations typically operate with very low profit margins. Opportunities to improve the revenue stream from hardwood rangeland properties should be considered in land-use planning decisions. Planning considerations should include opportunities for nontraditional ranch products and services such as composted manure and farm stays.

Property tax benefits

The value of reduced property taxes for owners of hardwood rangelands should not be overlooked. The Williamson Act provides a benefit for lands maintained in agricultural and certain open space uses. Under the Williamson Act the landowner enters into a contract with the county or city to restrict land uses to those compatible with agriculture, wildlife habitat, scenic corridors, recreational use, or open space. In return, the local authorities calculate the property tax assessment based on the actual use of the land instead of its potential value assuming full commercial development. To be eligible, the land must be designated by a city or county as agricultural preserve, scenic highway corridor, or wildlife habitat area.

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Glossary

biological diversity, or biodiversity. The variety of life and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur.

California Environmental Quality Act (CEQA). An act passed by the California Legislature in 1970 that requires environmental review prior to approval of a private or public project that may adversely affect the environment. CEQA works to ensure that government agencies consider possible significant impacts of proposed projects.

candidate species. A species for which the U.S. Fish and Wildlife Service or NOAA Fisheries has on file sufficient information on biological vulnerability and threat(s) to support a proposal to list as a threatened or endangered species under the Endangered Species Act.

categorical exemption. An exemption from CEQA for projects that the California Secretary for Resources has determined generally do not have a significant effect on the environment.

coarse woody debris. The amount of wood debris that accumulates in streams that affects stream flow and provides protection for fish and other organisms.

community plan. A planning vehicle that reflects the goals and policies of each individual community. Community plan policies are intended to guide the physical development of a community on a more detailed basis than the general plan.

conditional use permit (CUP). Also known as special use permit or use permit, a CUP allows specific land uses in zones not normally allowed for a particular site to ensure that the proposed use is compatible with the surrounding neighborhood. Typical CUPs are hospitals and gas stations or temporary uses such as Christmas tree sales.

connectedness. Parcels of habitat joined in such a way to achieve conservation goals.

conservation. The planning and management of resources or assets so as to secure their wide use and continuity of supply while maintaining their quality, value, and diversity. Conservation implies active management to assure sustainable resource use and allocation.

conservation easement. A deed restriction landowners voluntarily place on their property to protect land. The landowner either sells or donates the development rights (some or all) of the property to a qualified conservation organization or public agency to restrict the use of the land and conserve specified conservation amenities in perpetuity.

cumulative impact. Two or more environmental effects which, when considered together, are considerable or which compound or increase other environmental impacts.

demographics. The statistical characteristics that describe human populations and their trends.

direct impact. Primary environmental effects that are caused by a project and occur at the same time and place.

drip line. The area under a tree defined as the distance between the main trunk extending to the farthest branch tip. This area has the highest concentration of roots.

ecoregion. A territory defined by a combination of biological, social, and geographic criteria, rather than geopolitical considerations; generally, a system of related, interconnected ecosystems.

ecosystem. A dynamic and interrelated complex of plant and animal communities and their associated nonliving environments.

eminent domain. The authority given to federal agencies to condemn land for the public good.

endangered species. A species officially recognized by federal and state agencies to be in immediate danger of extinction throughout all or a significant portion of its range.

environment. The physical conditions that exist within an area which will be affected be affected by a proposed project. The conditions include land, air, water, minerals, flora, fauna, noise, and objects of historical or aesthetic significance.

environmental assessment (EA). A concise public document, prepared in compliance with the National Environmental Policy Act, that briefly discusses the purpose and need for an action and the alternatives to such action, and provides sufficient evidence and analysis of impacts to determine whether to prepare an environmental impact statement or finding of no significant impact.

environmental impact report (EIR). A detailed review of a proposed project, analyzing significant effects on the environment, reasonable alternatives, and mitigation measures to the project.

environmental impact statement (EIS). A detailed written statement required by the National Environmental Policy Act, analyzing the environmental impacts of a proposed action, adverse effects of the project that cannot be avoided, alternative courses of action, short-term uses of the environment versus the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitment of resources.

ephemeral stream. A stream that only flows in direct response to storms.

eutrophic. A condition by which a body of water is enriched with dissolved nutrients that stimulate the growth of aquatic plant life.

exemption. An environmental document exempting a project from the California Environmental Quality Act based on a finding that the project does not have significant effects on the environment.

extinct. The loss of a species across its entire range.

extirpate. The loss of a population of a species within a portion of its range.

fee-title. The acquisition of most or all of the rights to a tract of land. A formal conveyance of a title is also a total transfer of property rights. While a fee-title acquisition involves most rights to a property, certain rights may be reserved or not purchased, including water rights, mineral rights, or a use reservation (the ability to continue using the land for a specified time period, or the remainder of the owner's life).

findings. Written legal conclusions prepared by a public agency that explain the disposition of each significant environmental effect and alternative identified in an EIR.

fragmentation. The disintegration of connected parcels of habitat, creating fragments of what was once a contiguous block of habitat.

general plan. The supreme document from which all local land use decisions must derive.

greenbelt. An area of open space that is protected from urban development in order to check sprawl, safeguard the landscape from further encroachment, prevent towns from merging and assist urban regeneration.

habitat. The place or environment where a plant or animal naturally or normally lives and grows.

habitat barrier. A artificial or natural obstacle that limits species movement within its range or habitat, e.g., a highway, a waterfall.

habitat corridors. Connected parcels of suitable habitat that serve as a passageway for species to traverse their habitat, e.g., riparian zones.

herbivory. The act of foraging, grazing, browsing by a herbivore.

indirect impacts. Impacts caused by a project that occur later in time or at some distance from the project; however, they are still reasonably foreseeable. Also referred to as secondary effects.

infill. Construction of new facilities such as housing or commercial centers in existing urban or suburban areas. Infill development may range from development on vacant lots to the reuse of underutilized sites, such as older strip malls.

intermittent stream. A stream that flows during and for a period following rainfall or snowmelt.

lead agency. The public agency that has the principal responsibility for carrying out or approving a project.

lease. A short-term (usually 5- to 10-year) agreement for full or specified use in return for a rental payment (usually annual) and generally includes occupancy rights. The rights revert back to the owner at the termination of the lease. This device is useful when the objectives are short-term or the owners are unable to provide other forms of land transfer. The property remains on the tax rolls during the term of the lease.

mitigation measures. Actions included in a proposed project's environmental impact report that reduce or eliminate a project's significant environmental effects.

mixed use. A variety of residential, commercial, and office uses typically associated with or along a transit corridor. Mixed-use development specifically calls for higher-intensity uses along transit lines.

National Environmental Policy Act (NEPA). The law that requires a federal agency to consider every significant aspect of the environmental impact of a proposed action; to involve the public in its decision-making process when considering environmental concerns; to use a systematic, interdisciplinary approach to decision making; and to consider a reasonable range of alternatives in every recommendation or report on proposals for legislation and other major federal actions significantly affecting the quality of the human environment.

negative declaration. An environmental document that states that after an initial study, a proposed project shows no significant environmental effects, or, in light of potential substantial effects, the project has been revised to mitigate substantial affects and that the new, revised project does not substantially affect the environment. A negative declaration entails that an environmental impact report is not required.

nest cavity. A nest chamber in the truck or branch of a tree excavated by woodpeckers or created by disease and/or wind.

non-point source (NPS). Sources of water pollutants that do not emanate from a pipe or other source. Soil erosion and animal waste are non-point sources.

patch size. A descriptive term used to quantify the remnant areas of habitat that have been reduced to "islands" surrounded by alternative or incompatible land uses.

perennial stream. A stream that flows year-round. Often referred to as a "blue line" stream on maps.

preservation. A term that implies both passive and nonconsumptive land-use management strategies.

public involvement. The process by which interested and affected individuals, organizations, agencies, and government entities participate in the planning and decision-making process.

rezoning. A change of zoning.

riparian zone. The area within a stream that includes the stream channel, bank, and vegetation within the flood zone.

root protection zone. An area including and extending one-half the distance of the drip line from the main trunk of a tree.

significant effect. A substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by a project.

snag. A tree that has died but remains standing.

specific plan. A detailed policy plan that identifies allowable land uses and infrastructure needs for a specific geographic area. Zoning, subdivision, and public works decisions must be in compliance with specific plans.

threatened species. Any species that is likely to become an endangered species in the foreseeable future throughout all or a significant portion of its range.

threshold of significance. An identifiable quantitative, qualitative, or performance level of a particular environmental effect. It is evaluated based on noncompliance, which means that the effect is determined to be significant by the agency, and by compliance, which means the effect is determined to be less than significant.

total maximum daily load (TMDL). An initiative by the U.S. Environmental Protection Agency (EPA) to establish acceptable levels of non-point source pollutants for streams, rivers, and lakes.

urban policy area. The area expected to receive urban levels of public infrastructure and services within the 20-year planning period.

variances. A limited waiver of development standards to allow flexibility through variations from development standards such as setbacks. Variances are usually changes to physical characteristics to allow for development.

viewshed. A part of the landscape important for its scenic quality. It may include a composition of terrain, geographic features, and/or vegetation.

wildland-urban interface. The area in which residential and suburban development come into contact with lands in a "wild," or undeveloped, state.

Williamson Act contracts. Voluntary contracts between landowners and a city or county in which the landowners agree to keep their lands in agriculture for a minimum of 10 years, renewable up to an additional 10 years. In return for entering into this contract, the landowners receive property tax relief on the lands under contract.

zoning. Specific immediate uses for land that are adopted by ordinance and carry the weight of local law. Zoning is the primary instrument for general plan implementation.

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This *Guide* is only one source of information you should consult when trying to develop or amend an oak woodland conservation strategy. In addition to providing oak-specific ideas and suggestions, the sources listed below can provide further guidance and assistance in oak woodland planning. Additional sources can be found in the references section at the end of chapters 2–4 and 6–9 of this book.

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