

WILDLIFE AMONG THE OAKS

A MANAGEMENT GUIDE FOR LANDOWNERS

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AS EUROPEANS first explored the land to be called California, they were awed by the abundance and variety of wildlife they encountered. Journals were filled with glowing accounts: "I have no where seen game as plenty," "Herd of hundreds and hundreds of red deer and the stag (elk)...were bounding about." In Europe, such reports enhanced the mystery and allure of the growing California legend.

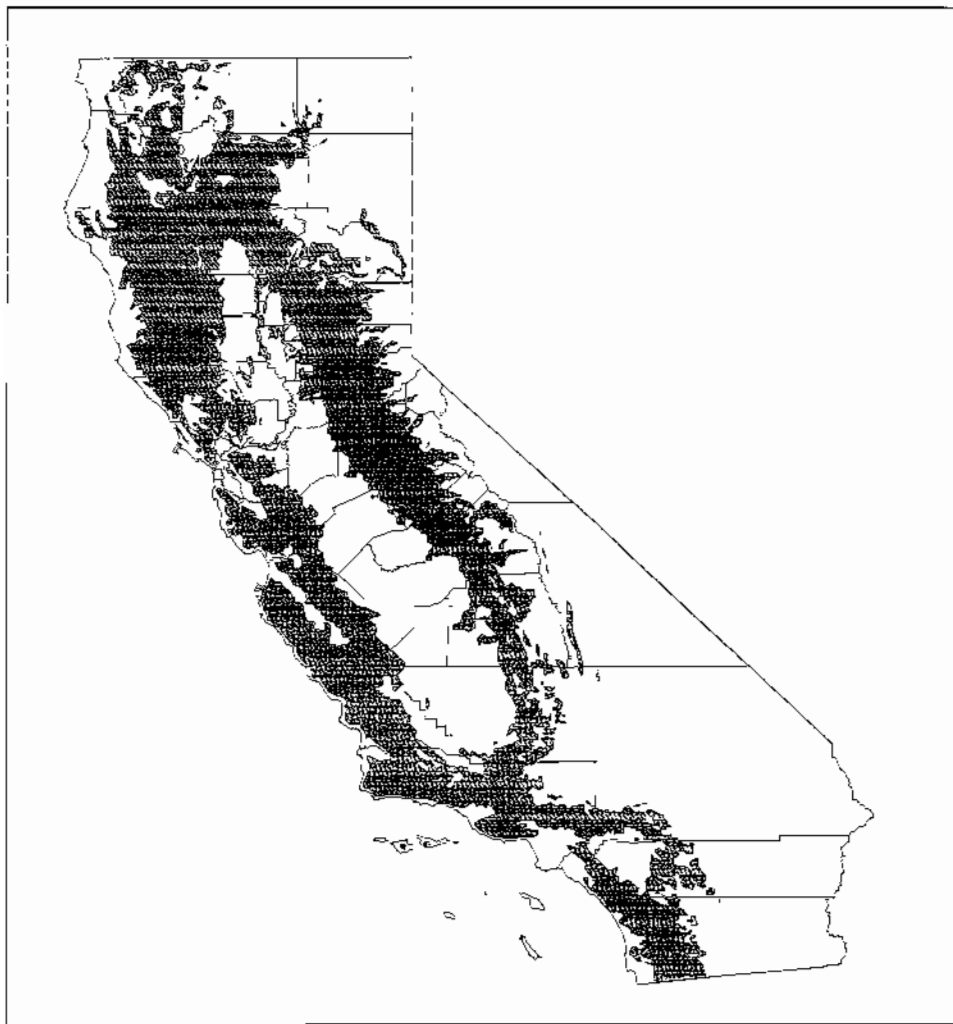
It is no wonder that California did—and still does—sustain an abundance and diversity of wildlife. The wildlife inhabitants of a place are largely determined by the habitat—those basic resources that offer food, water, shelter, and space. The quantity and variety of these resources in large part determines the types and numbers of wildlife inhabitants. California's rich wildlife heritage is the result of its diverse complexes of natural habitats. Of all California's rich habitats, those dominated by oak trees—commonly called oak woodlands, hardwood range, or oak rangelands—are among the most favored by wildlife.

Oak woodland values. California's oak ecosystems offer far more than just wildlife resources. In addition to the critical role healthy ecosystems play in soil development, erosion control, nutrient cycling, and sustaining air and water quality, the aesthetic values of oak landscapes have been appreciated throughout history.

CONTENTS

INDEPENDENCE OF OAKS	PAGE 2
AND A LEGEND	PAGE 2
YOUNG OAKS	PAGE 3
WATER	PAGE 3
SHADE	PAGE 3
WILDLIFE	PAGE 3
ADDITIONAL RESOURCES	PAGE 15

The bald eagle may be found in the oak woodlands during its winter migration.
Photo by "Moose" Peterson



Oak Woodlands cover nearly 8 million acres of California. This map displays the combined ranges of eight tree-sized oaks: the valley oak, blue oak, Oregon oak, black oak, coast live oak, interior live oak, canyon oak and Engelmann oak. (B. Appleyard, 1992. After Griffin and Critchfield, 1977.)

The state's earliest European explorers commemorated oak landscapes in place names like Encino, Thousand Oaks, and Oakland. Today, many consider a golden, rolling grassland, embellished with scattered oaks, as the classic California landscape—a perception that adds to the appeal of oak properties and contributes to higher land values.

For hundreds of years, oak woodlands have supported enterprises such as livestock grazing, firewood harvesting, and hunting. Today, recreational uses such as hiking, picnicking, camping, wildlife observation, and photography further enhance the economic benefits of managing oak woodlands. Revenue and woodland preservation are by no means mutually exclusive. In the hands of a creative landowner, they can offer a mix of returns far into the future. It is not surprising that landowners are currently making great

efforts to preserve the beauty and viability of oak landscapes in urban, suburban, and rural settings.

Trouble in the oak woodlands. In spite of the many widely recognized values of California's oaks, there is a growing concern for the health of dwindling oak habitats and the wildlife nurtured within them. The past 45 years of rangeland clearing and development have compromised over one million acres of oak woodland. Since the 1970's, rangeland clearing has decreased substantially, but urban and suburban development currently threatens to claim another quarter million acres.

Habitat loss creates many problems for wildlife. Subdividing large parcels interrupts habitat continuity. Plant dispersal and animal movements are impeded and overall quality of remaining habitat declines. Even scattered, low-intensity

development creates barriers to wildlife movement. Other changes accompanying development, such as the introduction of exotic plants and domestic animals—even pets—affect wildlife far beyond the confines of a backyard. The problems created by habitat fragmentation are increasing even in those areas of the state where the lands retain their rural appearance.

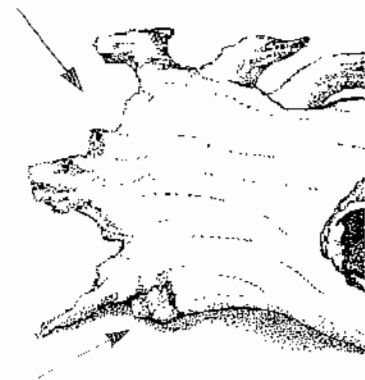
Wildlife among the oaks. This publication has been prepared for you—the landowner—to provide information and assistance as you make management decisions that affect wildlife in your oak woodland. Selected references and other sources of information are also provided and are listed in "Additional Resources". Hopefully you will find the information and ideas useful, not only to yourself, but also to all those interested in maintaining or improving the abundance and diversity of our wildlife among the oaks.

1. Clarke, A.B. 1852. *Travels in Mexico and California*. Wright and Hasty's Steam Press, Boston.
2. Dana, Richard Henry, Jr. 1949. *Two years before the mast*. Doubleday, New York.

HABITATS PROVIDED BY THE FALLEN OAK

Geri Hulse-Stephens, 1991

THE ROOT WAD IS USED BY FLYCATCHERS FOR PERCHING, BY CALIFORNIA QUAIL FOR OUSTING, AND BY JUNCOS FOR NESTING



THE TRUNK PROVIDES A FOOD SOURCE FOR WOODPECKERS.

THE INTERDEPENDENCE OF OAKS AND WILDLIFE

CALIFORNIA'S oak habitats are diverse and extensive. Nineteen species of native oaks nine of which grow to tree size—occur on approximately 20 million acres, or roughly 20 percent of the state. Oak woodlands—those low elevation, wooded areas dominated by oak species—cover nearly eight million acres. This diversity, distributed through a variety of settings and climatic conditions, helps create many different habitats. Over 50 oak habitat types were recently described, each with its own ecological processes and wildlife relationships. It is no wonder that oak woodlands are critical to the state's wildlife.

The significance of California's oak woodland habitats lies in more than merely diversity and distribution. They are also unusually rich in the shelter and food resources needed by wildlife. At least 331 vertebrate species—terrestrial mammals, birds, reptiles, and amphibians—use oak habitats in some fashion during their

breeding seasons. Many other species require oak woodland resources during other phases of their lives such as for migration or wintering. Oak woodlands are especially rich in bird life: observers have recorded nearly 160 species in these habitats. Additionally, more than 60 species of mammals—fully one-third of all mammals found in California—also depend on oaks. The well-being of these species clearly depends upon the health of available habitats.

But it is not just oaks that nurture wildlife. The wildlife, in turn, nurtures the oaks. The hundreds of animals that rely on oak habitats are believed to enhance conditions for oak survival and regeneration through complex interrelations. Although many components of these interdependencies are not well understood, each new insight gained through study supports a picture of their inseparable character: wildlife cannot survive without its woodland home and the woodland cannot survive without its wild inhabitants.

IMPORTANCE OF OAKS TO WILDLIFE

> Food Use

Oak habitats offer diverse resources to wildlife: shade in the summer, shelter in the winter, perch sites, roost sites, nest sites, nest cavities, and food. Food, food. . . Acorns are an obvious food resource—one that is especially plentiful, and rich in calories—but oak catkins, twigs, leaves, buds, sap, galls, fungi, lichens, and even oak roots also provide important foods. The oak itself is not the only source of food in these habitats. Plants that grow with oaks, such as redberry, coffeeberry, toyon, mistletoe, poison oak, and various species of ceanothus, manzanita, forbs, and grasses are also important foods for wildlife.

These oak woodland plants sustain an abundance of small organisms that supply other wildlife foods. Insects feeding in oak habitats are eaten by birds, reptiles, amphibians, mammals, and other insects which, in turn, feed larger predators such as owls, hawks, snakes, bobcats, coyotes, and mountain lions.

> Season after Season

Although oak habitat resources and abundance vary from season to season, the oak woodland has something to offer wildlife throughout the year.

Spring. Wildlife probably make the greatest use of the oak woodland in the spring. Trees are putting out new leaves and flowers that attract insects, which are then consumed by other species of insects and birds. Since most bird species feed their young on insects, this bloom in insect life readily attracts nesting birds. The growth of new leaf material also attracts small mammals such as western gray squirrels and browsing animals like deer. In addition, new leaf material adds to the shelter resources the oak woodland offers.

Summer. Food resources in the oak woodland continue all summer, although insect populations decline as leaf growth slows. Some oaks may also experience a second or third flush of growth, which

ELEVATED AREAS ARE USED AS LOOKOUTS AND FEEDING SITES

LIMBS ARE USED AS PERCHES, AND IF HOLLOW, AS NEST CAVITIES

THE SPACES BETWEEN LOOSE BARK AND WOOD ARE USED AS HIDING AND THERMAL COVER BY INVERTEBRATES AND SMALL VERTEBRATES, SUCH AS THE PACIFIC TREEFROG

PROTECTED AREAS ALONGSIDE THE LOG ARE USED AS NESTING COVER BY CALIFORNIA QUAIL AND OAK-EYED JUNCOS, AND AS HIDING AND THERMAL COVER BY RABBITS.

Valley oak, (*Q. lobata*).

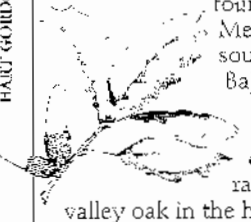
This tall, spreading deciduous oak was once an important member of the Central Valley's riparian forests. From Shasta County to Los Angeles County, it is still a conspicuous oak in the hardwood range, in valley bottoms and on deep alluvial soils.

**Blue oak, (*Q. douglasii*).**

This deciduous oak is the dominant oak of the hardwood range from Shasta County to Kern County. Where it shares its range with the valley oak, blue oak generally occupies the more shallow soils, steeper slopes, and upland sites.

**Coast live oak (*Q. agrifolia*)**

This is an evergreen oak found from southern Mendocino County southward into northern Baja California, primarily west of the coast ranges. In the southern portions of its range, it replaces the valley oak in the hardwood range, and in valley and alluvial sites, it often attains a tall spreading appearance.

**Interior live oak (*Q. wislizenii*).**

This evergreen oak is widely distributed in California from Siskiyou County south into Baja California. It is abundant in the Sierra Nevada foothills and in the coast ranges occupies the higher, drier, or more inland sites than the coast live oak. Interior live oak is found in more heavily wooded sites than the blue oak. In chaparral habitats or other dry locations, it develops a scrubby form.

**Engelmann or mesa oak (*Q. engelmannii*)**

This semi-deciduous oak has a limited distribution in less than 2 percent of the state—primarily in western San Diego County. There, the mesa oak replaces the blue oak in the hardwood range.



Steller's jays, like this one, along with other birds and mammals, inadvertently "plant" acorns when they store them in the ground.

may enrich the local food web. Additionally, oaks provide refuge from direct sunlight and high temperatures during the hot summer months. This shelter is sought by many animals, including domestic livestock. Similarly, grasses and other herbaceous plants, protected from the summer sun by the oak canopy, often remain green longer into the summer than plants growing in unshaded areas. This green, living food is eaten by many animals.

Fall. Although some of the food resources found in the oak woodland diminish during summer, the larder is restocked with the fall arrival of nuts, fruits, and seeds. The acorn crop peaks in September and October, and with it comes a flurry of wildlife to take advantage of this new, calorie-rich source of nutrition. Deer and ground squirrels move in to eat acorns off the ground. Ground squirrels also store some of their finds in underground food caches. The western gray squirrel selectively picks acorns not infested with insects. The well-being of such birds as the acorn woodpecker, scrub jay, and magpie depends, to various degrees, on the size of the acorn crop. These species have developed complex acorn storage strategies that, in turn, benefit oak regeneration. Other birds such as quail, towhees, and sparrows, as well as numerous kinds of small mammals, eat

the acorn pieces left behind by others. The concentrations of acorn eaters attract larger predators such as owls, gray foxes, weasels, coyotes, and snakes.

Winter. Even during the winter, the oak woodlands have much to offer wildlife. California's evergreen oaks—including coast, canyon, and interior live oaks—continue to offer leaf forage deciduous species have lost. Leaves also moderate winter temperatures, creating islands of warmer habitat. Many insects continue to use oak resources throughout the winter and thereby continue to offer food to many kinds of insect eaters. Acorns stored by squirrels and birds feed not only those industrious species, but also many other winter residents that find them. Various oak woodland plants also offer food during the winter. For example, mistletoe, a parasitic plant that grows in the branches of many oaks, is an important source of leaf and berry foods for many wildlife species all through the winter.

> Year after Year

A single, living oak creates a sphere of life that extends both above and below ground. As an oak matures and declines, the types and concentrations of food and shelter resources used by wildlife change seasonally and shift through the years. Wildlife use all parts of the oak's living sphere through all phases of the tree's life. As the tree grows in size, the abundance and diversity of resources expand from the leafy foods of the seedling and sapling to the banquet of leaves, fruits, flowers, galls, sap, and insects offered by the mature tree. Opportunities for nesting and shelter also expand with the age and size of the

OAKS OF THE HARDWOOD RANGE

California has 19 species of native oaks, 9 of which grow to tree size. Several of these are conspicuous members of the oak woodland

tree. To the creative landowner, these oak life phases—seedling, sapling, maturity and decline—offer different opportunities to attract and support wildlife.

The seedling. The tender young leaves of the seedling oak offer an important food source to insects, small mammals, and larger grazing and browsing mammals. Similarly, seedling roots provide tender foods to below-ground creatures such as pocket gophers, mice, moles, and ground squirrels. But oaks are most vulnerable to destruction during this stage and heavy consumption of seedlings may hamper over-all woodland regeneration.

If the overall number of individual oaks in the landscape is to remain constant through time, enough seedlings must survive to the tree stage to replace oaks that die. In the modern, human-altered oak woodland of California, the ecological balance of successful oak regeneration appears to have been altered. Changes in grassland plant species, high populations of deer, birds and small rodents, excessive livestock grazing, suppression of periodic fires, and other changes in the woodland, may all contribute to poor oak regeneration. When seedling production and seedling consumption are in balance, some seedlings—at least periodically—will survive to the sapling stage.

The sapling. After several years—much longer on poor sites or where herbivores suppress growth—the seedling becomes a sapling. A sapling oak is often short and shrubby in form. It is an important component of the shrub layer in the woodland, providing food and shelter to many wildlife inhabitants. Leaves are still the primary food resources, but are now more abundant. The greater volume and structure of leaves and branches begins to offer wildlife hiding and perching sites and shelter from extreme temperatures.

The short sapling finally outgrows the browsing pressure that keeps it scrubby and develops a tree form. Leaves continue to be the primary food it provides but the thicker, fissured bark begins to supply living sites and food for many insects. As height, volume, and structure of the sapling increase, so do possible sites for perching, roosting, and nesting. The tall sapling may also begin to produce some flowers and acorns, introducing a limited supply of these food resources.

The sapling stage continues as the tree gains height, varying in duration from 5 to 20 years on good sites, and up to 50 years or more on poor sites. As the tree attains full height, branch structure and canopy

expand. The tree is considered mature when it produces full crops of flowers and acorns.

The mature oak. The mature oak tree offers all of the resources of earlier stages, but in much greater quantity. Production of flowers and acorns can be profuse. The well-developed bark provides food for a diversity of insects that in turn attract birds and mammals. As the tree canopy expands, it adds organic material to the leaf litter, contributing to ground food resources. The spreading branches of a mature oak provide numerous roost, cover, and nest sites. Wood-rotting fungi create sites for construction of nesting cavities in the living tree. Nest cavities are especially important because many birds, notably several species of woodpeckers and owls, western bluebirds, white-breasted nuthatches, Bewick's and house wrens, and American kestrels will nest only in cavities.

The declining oak. As the tree declines in vigor, resource availability shifts. Cavity sites for nests become more plentiful, as do perching, nesting, and burrowing sites. Insect activity also increases, attracting insect predators. But as fungi disease, and insect activity intensify, the vitality of the tree declines further, and leaf cover, browse, and acorn production decrease.

The oak snag. Snags are standing trees that are dead or dying. No other woodland resource can offer the abundance of perching, roosting, and burrowing sites, as well as cavities for nesting, as the snag. Often viewed as hazards and liabilities by people, snags are important to wildlife because of the unique and abundant concentration of resources

they provide. Since living trees cannot offer such concentrations of resources woodland snags are used heavily by wildlife.

Insects flourish in and under the bark of snags, supplying important foods to birds, mammals, and reptiles. The cracks and cavities that develop in the bark and wood also provide nesting sites for birds and denning sites for mammals. Similarly, the bare branches of dead and dying trees offer prime lookout perches and roosting sites that are especially important to hawks and owls.

The fallen oak. As an old oak falls—usually piece by piece, branch by branch, over a long period of time—its perching, nesting, roosting, and food resources decline. However, it then offers new sites for burrowing, shelter for reptiles and amphibians, and shelter and perching sites for small mammals. The work of insects and fungi continue as the wood rots and



Oak snags offer wildlife unique resources.

SHARON G. JOHNSON

disintegrates, adding nutrients and organic material to the soil, perhaps to be recycled into a living tree.

> The Natural Oak Community

In a natural oak community, all of the oak life stages are present, and the resources they offer wildlife abound. But as humans manage woodlands, the tendency is to remove snags, as well as dead and downed wood, thereby reducing the availability of resources they alone provide. In managing habitat for wildlife, all life stages play an important role and should be maintained.

IMPORTANCE OF WILDLIFE TO OAKS

Perhaps the most significant way wildlife benefit oaks is by dispersing acorns. Scrub jays, magpies, and western gray squirrels, among other animals, store acorns in the ground, enhancing dispersal and germination possibilities. Probably the most industrious acorn "planter" is the scrub jay. Scrub jays inhabit most of California's oak woodland, and may annually cache billions of acorns! A jay retrieves and eats only a portion of the acorns it stores. The remaining acorns—protected by the soil from many acorn predators—may sprout. Several observers note that areas of good oak regeneration often occur where scrub jays are active.

Such interdependencies between oaks and wildlife are only beginning to be examined by researchers, but studies thus far suggest intriguing complexity. For example, small mammals may eat mycorrhizal fungi and pass the spores into the soil where they may attach to young oak tree roots. These fungi are believed to enhance the oak's uptake of inorganic soil nutrients. Another important but little-studied example is the role of small burrowing mammals and other soil organisms in digesting and depositing plant material, mixing and aerating the soil, and contributing to overall soil development.

Given the great and conflicting land-use pressures currently facing the oak woodland, there is growing concern that these little-understood ecological relations may be compromised by human activities.

MANAGING OAKS AND WILDLIFE

Food, water, shelter, and space are the fundamental resources required by all living things. Their availability varies from site to site and season to season—just as needs vary between different wildlife species. It is the variety and distribution of resources in a landscape that attracts and sustains wildlife use. Your opportunities to attract wildlife to your land and encourage it to stay depend on how you manage the resources animals use.

Any management action—as well as non-action—or the indirect effects of other land-use activities affects wildlife resources.

Attracting and supporting wildlife can be approached in several ways. You may wish to encourage particular species of wildlife and manage your land to enhance resources that will draw these species. But actions that directly benefit one species may hamper the survival of another. Alternatively, you may wish to manage for species diversity by providing a general increase in the abundance of food, cover, water, and space resources. Or, you may choose to simply leave the land alone, and let nature take its course. Any management decision you make should be based on a careful consideration of the effect your actions will have on *all* wildlife—a difficult task given the current, limited availability of information about most wildlife species.

This section explores some of the habitat characteristics and processes of change that create diversity in California's oak woodlands. Working with the habitat itself is the primary wildlife management strategy available to landowners.

SOURCES OF HABITAT DIVERSITY

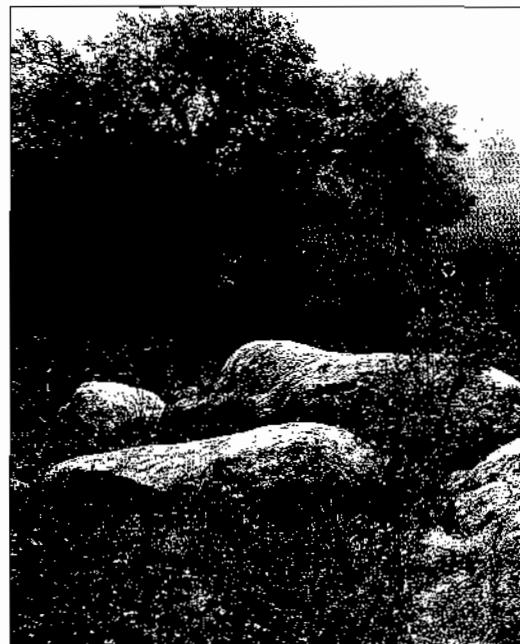
Habitat diversity is created by the variety of biological components of a site, and the spatial arrangement of rocks, plants, water and other components of the landscape. Composition and spatial arrangement of vegetation in a landscape change through time, contributing to variety in the resources available to wildlife.

> Vegetation Composition and Plant Succession

The types, numbers, and ages of plants at any site undergo constant change. If you were to watch a single piece of land through time, you might be surprised by the extent of these changes. After disturbance, such as fire, prolonged drought, tree harvest, or insect attack, new species of plants and animals come in to fill the vacancies created. This process—the progression of plants that occupy a site after disturbance—is called *plant succession*. Successional processes play a vital role in creating habitat diversity.

Plant succession creates different food and shelter resources at each successive stage. For example, if oak trees are thinned or removed, increased sunlight reaching the ground may cause a change in ground cover from sparse grass to heavy grass and shrubs. Food and shelter for wildlife also shift with these changes. Wildfire is a particularly important agent of natural habitat change in California, but rarely does it

Rocks, plants, water, and the arrangement of these features in the landscape all contribute to habitat diversity.



cause a complete shift in plant cover. Many species, including some oaks, survive burning through mechanisms that affect the habitat in other ways. Some may sprout from roots, trunks, or branches. Other plant species may germinate *only* after fire. The vigorous plant growth following sprouting or germination may increase the availability of certain wildlife foods. Similarly, sprouting may change the density and above-ground height of local vegetation, altering shelter resources.

The nature and rate of succession can vary considerably from site to site, depending on such factors as soil, slope, exposure to the sun, and local microclimate. Succession may also be influenced by the selective grazing habits of different domestic and wild herbivores.

Landowners who are aware of successional processes and how these changes influence wildlife resources are better able to evaluate the long-term effects of their land-use decisions. For example, a landowner may initiate disturbance to promote a variety of different successional stages. Alternatively, the landowner may allow these processes to proceed unimpaired.

> Spatial Arrangement of Vegetation

Plants and their component parts—leaves, branches, and canopy—can have a variety of arrangements in the vertical and horizontal dimensions. These arrangements have important effects on wildlife.



Riparian habitats create natural corridors of lush vegetation. Remnant corridors may persist in spite of encroaching agriculture and development. Caswell Memorial State Park, pictured above, protects one such area.

Vertical. In the vertical dimension, vegetation often occurs in layers, starting with the herbaceous layer (grasses and forbs) closest to the ground, followed by the shrub layer, and then the tree canopy. In some woodlands the canopy itself is made up of several layers. The layering of vegetation affects the duration and intensity of light reaching the lower areas of habitat which, in turn, affects the insects, plants, and microclimates. Multi-layered habitats combine the resources of all layers present, offering more opportunities for wildlife to find food and shelter. As a result, multi-layered sites, such as many oak habitats, support a great abundance and diversity of wildlife.

Land managers should consider the consequences of activities that tend to simplify or eliminate the lower layers of vegetation, such as cutting firewood, clearing brush, thinning trees, and grazing livestock. On the other hand, not all habitats important to wildlife have multiple layers. Single-layered habitats, such as grasslands, are also important to many species and should be maintained.

Horizontal. The distribution of different types of habitat or successional stages is called horizontal arrangement. Under natural conditions, disturbance and succession juxtaposes vegetation in different successional stages. Called interspersion, this mixing creates a variety of different food and shelter resources across an area and contributes to habitat diversity.

In California's human-altered landscape, a mix of disturbed and successional habitats already exists. Managing disturbance and succession to create interspersion is therefore not generally a priority of wildlife managers. Instead, the preservation of large blocks of remaining habitat is needed to support wildlife that relies on large, intact blocks of particular habitat types. If you have large areas of unbroken habitat on your land, maintain them whenever possible. In most cases this simple act yields the greatest benefit for local wildlife. Although single parcels of land may not contain large blocks of habitat, there are many ways landowners can work together to create such resources on a regional basis (see "Sharing Your Land with Wildlife").

> Corridors

Just as blocks of unbroken habitat are important to wildlife, so too is the ability of wildlife to move between habitat blocks. Zones of movement—called *corridors*—must provide adequate food, water, and shelter to meet animals' needs as they move between habitat areas. Migratory wildlife are especially dependent upon corridors to move between seasonal habitats. Corridors also allow animals to find mates and avoid the inbreeding problems of small, isolated populations. Similarly, young animals need corridors as they disperse and seek their own territories. Ripar-



SHARON G. JOHNSON

The acorn woodpecker is a common resident of California's oak habitats. These birds have developed the unusual habit of excavating storage holes in old trees, called granaries, and storing large quantities of acorns—one by one—in these holes during the fall. The woodpeckers then live off these acorns for the remainder of the year. Granary trees hold an average of 3,000 acorns, but an exceptional tree in the San Jacinto Mountains was estimated to contain 50,000 holes!

The habit of acorn storage goes along with very unusual and interesting social behavior in this species. Acorn woodpeckers live in groups of up to 13 to 15, limited most likely by the number the granary can support. The adults of a group are divided into breeders and non-breeding "helpers". All

adults generally help with storing acorns, raising the young birds, and defending their granary tree and the surrounding territory from intruders. Each member of the group can feed on the stored acorns at any time.

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 determines the food supply for the group throughout the year. If many acorns are stored, survival through the winter is high and raising young in the spring will be more successful. Research at the Hastings Natural History Reservation in Monterey County over a 20-year period



PHOTO BY PETER LINDEN

showed that four times as many groups with acorn reserves raised young, compared to groups that had exhausted their stores. In this way, the availability of acorns directly determines the number of acorn woodpeckers that occupy the oak woodland.

Acorn Woodpeckers and Livestock. Generally livestock and acorn woodpeckers coexist with minimal problems. In the long term, however, grazing may diminish the habitat if care is not taken to ensure oak regeneration.

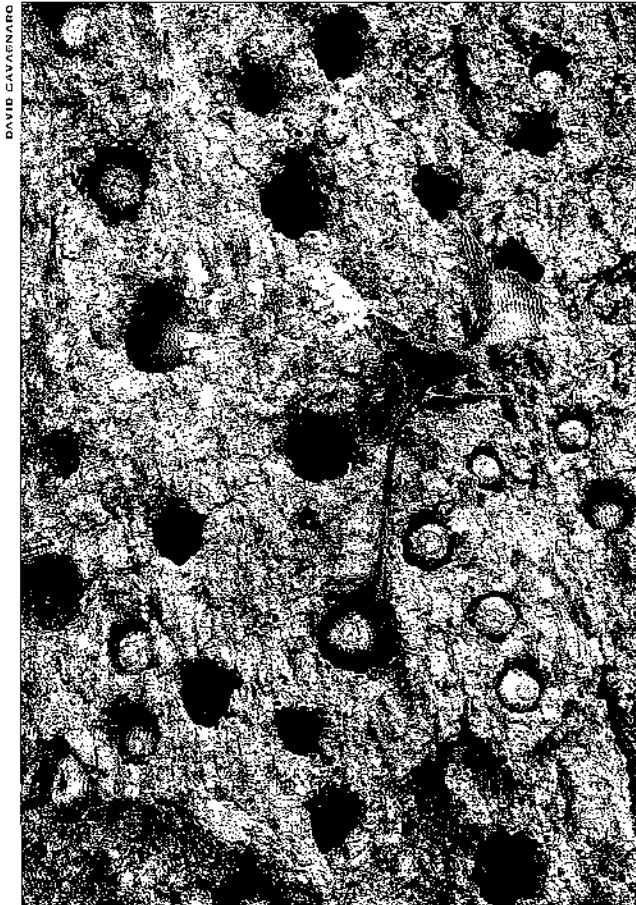
MANAGEMENT CONSIDERATIONS

Acorns and Granary Trees. The survival of acorn woodpeckers depends on the availability of acorns and suitable storage trees. Granaries are usually old, dying, or dead trees. When available, pines are most often used, perhaps because of their soft wood, but oaks, sycamores, and even redwoods are also used for this purpose. Granary trees have limited life spans, as even the sturdiest typically last only a few decades from when the woodpeckers begin to use them. Eventually the granary tree rots and falls. Woodpeckers usually abandon fallen granaries.

MANAGEMENT SUGGESTIONS

- Maintain good acorn-producing trees.
- Since the living space of a group of acorn woodpeckers can be as small as 10 to 15 acres, keep at least 10 granary trees per 100 acres of oak woodland habitat.
- If it is necessary to remove some granary trees, keep those with the most holes and, since old, large, living trees are potential granaries, they should be maintained whenever possible.

—William Tiejie and Walter Koenig



DAVID CAVAGNARO

ian areas, those zones of lush vegetation that develop around streams, are especially important natural corridors.

As natural habitats become fragmented by subdivision and advancing development, and as regional habitat quality decreases, corridors assume even greater importance as the primary means of connecting remaining areas of high quality habitat. People are currently becoming more aware of the importance of regional networks of habitat corridors. As a result, many innovative corridor plans are being implemented throughout California.

SPECIAL HABITAT RESOURCES

Among the food, water, shelter, and space resources that can be shaped through habitat management, the oak woodland provides several of exceptional value that deserve special consideration.

Acorns. Acorns are an important natural food resource throughout California's oak woodlands. Prior to European arrival, acorns may have supported more than a quarter million Native Americans—that's three quarters of California's indigenous population, which is thought to have been one of the most dense in the United States. Acorns are also used by a great variety of wildlife, including both native and exotic game species. Over 85 of California's terrestrial mammals and at least 30 oak-woodland birds eat acorns. Acorns make up much of the diet of acorn woodpeckers, band-tailed pigeons, scrub jays, wild turkeys, valley and mountain quail, mule deer, and wild pigs.

The productivity and abundance of acorn-bearing trees strongly influence the number of animals that can be supported at a site. Acorn yield varies tremendously from tree to tree and year to year. For trees of the same species and of similar age and size, the acorn crop may range from a few to several hundred pounds in a single year. Year-to-year acorn production may fluctuate due to variations in weather, natural acorn production cycles, or other factors which are little understood at this time.

Obviously, the most productive trees can support the most wildlife during the fall when acorns are available; thus, acorn production should be considered in many management decisions. If thinning is planned, make an effort to identify and preserve the trees that produce the most acorns. Observe the trees during Septem-

ber and October, preferably over several years, and note the trees that bear heavy acorn crops. The California Department of Fish and Game has developed an evaluation method to guide landowners in identifying good acorn-producing trees

Snags and cavities. Declining trees that are developing cracks and cavities, along with standing dead trees, known as "snags", offer special food and shelter resources to wildlife (see "The Interdependence of Oaks and Wildlife"). Viewed by many as liabilities and nonproductive components of the woodland, dead and dying trees are often the first targets of thinning and firewood cutting. Their widespread removal, however, seriously diminishes wildlife food and shelter and can have long-term negative effects on woodland inhabitants. Wildlife biologists strongly recommend that landowners leave some snags and cavity trees during any wood-cutting operation. Current guidelines suggest leaving one cavity tree or two cavities per acre of oak woodland

Water resources and riparian areas. The lack of surface-water restricts wildlife use in many California habitats. In almost all cases, augmenting this resource by adding ponds or watering devices such as cattle troughs, maintaining wet areas, or prudently managing stream resources to encourage year-round flow will encourage wildlife use during the dry season. These actions also maintain optimal habitat for reptiles and amphibians.

Natural stream-side habitats, known as "riparian zones," also offer special resources to wildlife. The trees in California's riparian forests are predominantly deciduous trees such as valley oak, alder, willow, big-leaf maple, sycamore, ash, and cottonwood. Riparian plants grow comparatively quickly and produce abundant, tender foliage

throughout the summer. In contrast to surrounding drier areas, riparian zones provide shelter, shade, surface water, and cooler, humid air to wildlife seeking refuge during the hot, dry summer months. Riparian zones also provide natural wildlife corridors that follow the meanders of streams across the landscape and facilitate wildlife movement.

The limited extent of riparian areas and their dependence on water make them especially vulnerable to damage from human activities. Agriculture, urbanization, and water diversion have already taken a heavy toll, claiming more than 90 percent of these woodlands in California's Central Valley. Because of their abundant wildlife resources, valuable water supply, and natural role as regional corridors, riparian zones deserve special consideration in any land management plan. Protecting or enhancing the riparian zone is one of the most important things any landowner can do for local wildlife.

"Fine jungles of tropical luxuriance." This is how John Muir described California's riparian forests in 1894 (The Mountains of California, reprinted in 1964 by Doubleday and Co., Garden City, New York).



STANLEY G. JOHNSON

SHARING YOUR LAND WITH WILDLIFE

Sharing your land with wildlife offers many possibilities and rewards. Among the rewards are abundant opportunities to observe wildlife in your immediate surroundings and the satisfaction of knowing that your efforts to manage for wildlife benefit the health of local and regional ecosystems. Management options can both attract and enhance local wildlife resources, as well as provide a variety of economic returns.

Living with wildlife, however, is not without its problems. Deer are notorious for eating landscape plants and their presence will need to be considered when designing gardens and landscaping. Often fencing, or the selection of "deer-resistant" plants is required. Similarly, deer, rodents, small mammals, birds, and livestock that eat acorns and seedlings may inhibit oak regeneration.

Many land management objectives may not be directly compatible with managing habitat for wildlife. Livestock grazing, for example, may compromise the multi-layered habitats and low shrubs that provide wildlife food and shelter. Firewood cutting can have a similar effect and may reduce the habitats offered by downed wood unless an effort is made to leave some brush piles and woody debris. Even management for game or other selected species can adversely affect the habitat for other woodland inhabitants. These and other possible conflicts should be considered in designing your land-management objectives and choosing between options and compromises.

EVALUATING WILDLIFE POTENTIAL

The first step in managing land for wildlife is gaining an understanding of which wildlife and habitats are available. The greatest management success will be achieved by enhancing those resources that occur or, given proper management, would occur naturally on your land.

> Evaluating Wildlife Resources

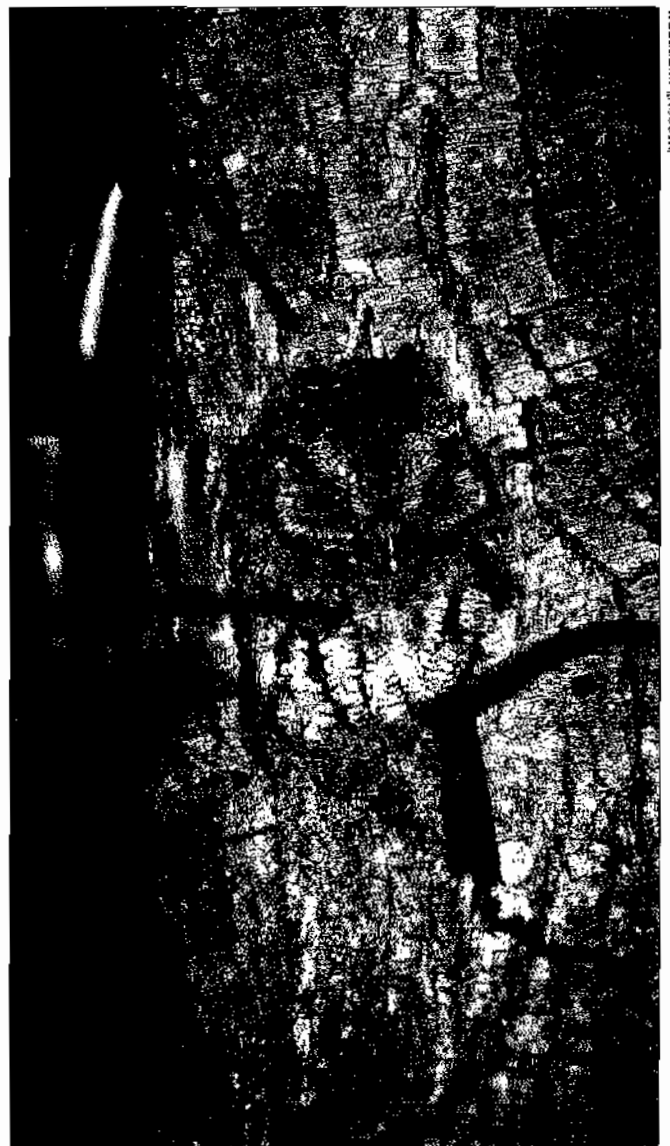
A basic evaluation of wildlife resources includes the identification of what wildlife are present, what their needs are, how they utilize available resources, and what species could be attracted or introduced to the site. You may wish to consider the re-establishment of native species driven from the land by past land uses or the introduction of nonnative species such as wild turkeys—a task that would actually be carried out by the California Department of Fish and Game. A variety of techniques is available to assess wildlife resources on your land. You may also wish to consult a professional wildlife biologist for assistance.

> Evaluating Habitat Resources

Different wildlife species eat different foods, seek shelter in different settings, and select different sites to raise their young. Although the resource needs of various species may overlap, each requires a unique combination of resources. To attract wildlife to your land, you need to consider exactly what those animals require to thrive. Do they eat grass, or do they browse on shrubs and other broadleaved plants, as do deer? Do they need brushy areas for cover as quail do or, as with many birds, do they nest in the branches of living trees or require nesting cavities? How do wildlife use available habitat and how may their ability to use these areas be improved? Answers to these and

other similar questions will help you understand how your oak woodland fits the needs of local wildlife and how its food, cover, and water resources may be enhanced. Once again, the services of a professional wildlife biologist may be needed.

Seasonal habitat needs. As the seasons change, wildlife need different things from their habitats. Food sources shift with the seasons and vary in availability. Shelter needs also change with the weather. Look carefully at the wildlife that use your land, and determine whether they are seasonal or permanent residents. Then carefully consider what resources they use



*Flame-colored owl
in an oak cavity.*

throughout the year, and how these resources may be enhanced.

Many species migrate to meet seasonal habitat needs. Although some feeding and resting areas may be used only during migration, they are nevertheless critical to an animal's survival. Corridors may also be required to accommodate the seasonal movement of wildlife (see "Managing Oaks and Wildlife"). Corridors are especially important for flightless creatures, but even many species of birds will not migrate without them.

SPATIAL SCALES OF HABITAT MANAGEMENT

When considering habitat management options, evaluate the amount of land you have for wildlife. Trying to attract wildlife to a suburban backyard is a much different task than attracting wildlife to a yard next to a regional park, or to a ranch surrounded by rangeland. Since the boundaries of animals' foraging territories rarely coincide with human boundaries, regional resources greatly influence and expand the wildlife potential of a single parcel.

Backyard. Backyard wildlife possibilities are constrained by the amount and quality of available habitat. The best objective for smaller parcels is to attract wildlife from neighboring lands, either from other yards, a park, or from open space areas. Birds, for example, often respond quickly to measures that enhance their food supply, such as the establishment of berry-producing plants, the creation or enhancement of shelter and surface water supplies, and the direct supplementation of food resources through feeders. Raccoons, fox, coyotes, squirrels and sometimes even deer may also be attracted by these measures; however, these species may become a nuisance in urban settings.

Ranch. As the parcel size expands, so do the possibilities for wildlife enhancement. Habitat types may diversify, and larger habitats can attract species from outside areas, as well as sustain resident individuals or populations. Whether managing a ranch of tens of acres or thousands of acres, you can encourage wildlife use by any action that augments food, shelter, and water. Larger properties also provide landowners opportunities for cost sharing and other incentive programs offered by agencies such as the California Department of Fish and Game, Soil Conservation

MULE DEER

A common and widespread resident of California, the mule deer is found throughout the state except in extreme desert areas and the intensively farmed Central Valley. Mule deer may be migratory, as in the northern part of their range, or nonmigratory. Oak woodland habitats are important for both, as they provide seasonal winter range for migratory deer and year-round habitat for non-migratory or resident deer. Mule deer prefer habitats that contain a mosaic of wooded and riparian areas, shrublands, and grasslands that provide necessary food and cover.

HABITAT REQUIREMENTS

Food. Acorns, browse, forbs, and grasses are common components of deer feeding habitat. Browse is provided in the oak woodland primarily by edible shrub species that occur in the woodland understory. Forbs and grasses are eaten primarily during the spring when green and nutritious. Acorns become a major part of the deer diet in the fall, and are important in helping deer survive the winter months.

Cover. Deer need hiding cover in proximity to foraging areas for security from predators and for sheltering their vulnerable fawns. Hiding cover can be provided by shrub vegetation and all age classes of oak trees (seedling to mature). Thermal cover in mature tree or shrub stands helps buffer the extreme weather that occurs in win-



"MOOSE" PETERSON

ter (cold and wind) and summer (heat).

Water. Deer need water for drinking. Adequate water supplies are especially important to adult does with nursing fawns during the summer.

MANAGEMENT SUGGESTIONS

- Maintain good acorn producing trees.
- Maintain a diversity of shrubs in varying age classes. In dense stands, small clearings can enhance herbaceous forage production.
- For thermal and fawning cover, maintain dense north slope areas, shrub patches, and riparian areas.

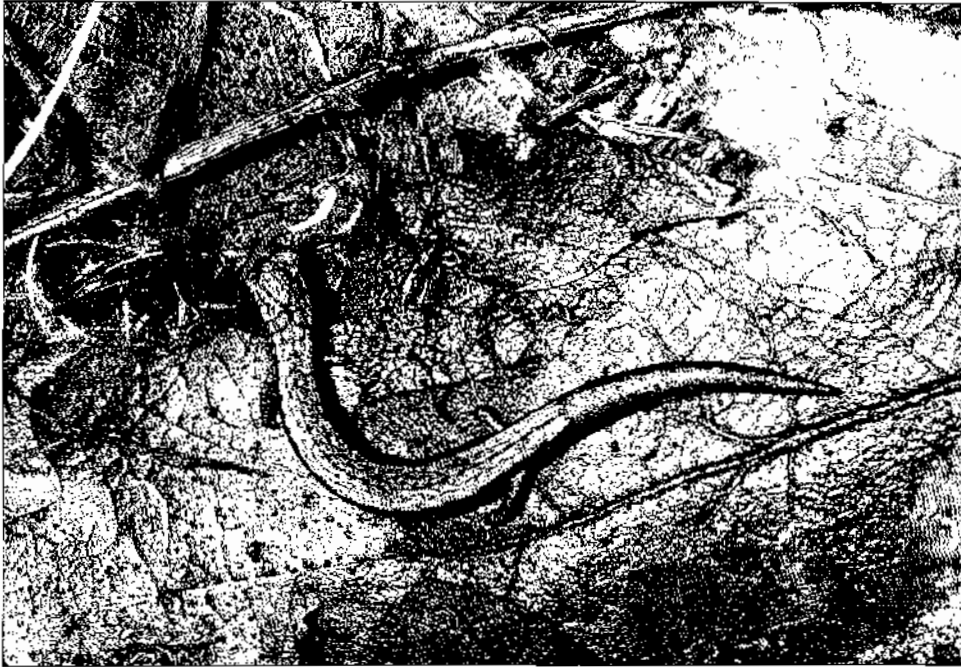
- Reduce grazing disturbance during the fawning season and exclude cattle from known fawning areas during spring to late summer.

- In general, graze the woodland only moderately to reduce competition for acorns and browse, and retain the forb component.

- Provide drinking water for deer and other wildlife by managing surface water supplies, supplementing supplies by enlarging seeps, constructing ponds, or adding other watering devices. Water should be available within a half mile of any habitat area.

—William Tietje
and Eric Loft

California Slender Salamander



LARRY SERVA

Salamanders and other amphibians (salamanders, newts, frogs, and toads) are cold blooded; meaning that their body temperature is determined by their surroundings. The skin is usually smooth with many glands that produce a secretion that makes some salamanders distasteful to other animals. Several kinds of salamanders occur in oak woodland habitat. The most common and widespread include the ensatina, arboreal, and several species of slender salamanders.

Salamanders lay eggs in streams or ponds or in dark, damp locations on land. The young of most species of salamanders live in the water. Adults live both in water and on land. Water passes freely through the skin of adult salamanders so they will dry up if they have no access to water. Amphibians, including salamanders, are reportedly declining in

numbers worldwide. Some reasons for their decline in California may be acid rain, introductions of new species of reptiles and amphibians which eat native amphibians, and the loss of wetland habitat.

HABITAT REQUIREMENTS

Food. Salamanders sit and wait for prey or slowly stalk their food. They eat earthworms, snails, slugs, insects, other small invertebrates and fish eggs. Small fish and even small mammals may occasionally be eaten. Salamander young eat aquatic insect larvae, plankton, snails, and tadpoles.

Cover. Salamanders typically seek the grassy understory of riparian areas. During wet periods in fall, winter, and spring, salamanders are active above ground and seek cover under logs, rocks, and

in damp leaf litter. When the soil dries during late spring and summer, moister conditions are sought in rodent burrows and other wetter places underground.

Water. Salamanders require moist conditions at all times. They will not survive if moist conditions are not close at hand.

MANAGEMENT SUGGESTIONS

- Maintain healthy riparian habitat.
- It may be necessary to manage livestock grazing in some areas.
- Maintain dead and down woody material for moist cover for hiding and feeding.

—William Tietje
and Frederick Andoli

Service, and the California Department of Forestry and Fire Protection. Information on these programs can be obtained from the agencies listed on the back cover of this brochure.

Community landscape resources.

Whenever adjacent or nearby parcels can be managed cooperatively for common objectives, wildlife enhancement options increase. Today, many communities, wildlife management agencies, and landowner associations are experimenting with wildlife easements, wildlife corridors, wildlife management of common areas, and other mechanisms that pool local resources for the benefit of wildlife. The primary thrust of these innovative efforts is to expand the extent, diversity, and quality of available habitat, and to provide corridors for wildlife movement between islands of habitat.

MULTIPLE-USE MANAGEMENT OPTIONS

To an attentive and creative landowner, managing oak woodlands for wildlife also allows a variety of other uses. The following discussion offers a few thoughts on multiple-use options for owners of oak woodland.

Livestock management and wildlife.

Historically, livestock ranching has been an important economic use of the oak woodland. In fact, the long-term stewardship of the oak woodland resource by ranchers has helped sustain large expanses of quality wildlife habitat. Today, livestock grazing occurs on nearly six million acres of California oak woodland.

One consideration in managing for both livestock and wildlife is the direct impact of stock on oak habitats. Livestock may alter the woodland by reducing the understory and simplifying the vertical structure. This will adversely affect habitat for some species, and improve habitat for others. Livestock may damage trees and roots as animals congregate under the tree canopy, compacting the soil, and chewing or rubbing on bark. Livestock may also contribute to regeneration problems by eating acorns and seedlings. Unmanaged riparian grazing may trample sensitive streamside environments, alter plant communities, increase erosion, and diminish water quality.

Many of these problems can be avoided or minimized by thoughtful management that anticipates potential problems.

CUTTING FIREWOOD

Planned grazing systems, such as short-duration grazing and deferred-rotation grazing, provide landowners opportunities and flexibility in maintaining wildlife habitat on areas grazed by livestock. Use of planned grazing systems could be directed specifically at encouraging oak regeneration, creating areas of multi-layered habitat, and protection of riparian and other sensitive areas. In certain situations, installation of protective devices (screens, fences, or other physical barriers), to keep animals away from sensitive sites or individual oak seedlings and sapling trees, may also be advised. Information on these and other management techniques is available from the public agencies listed in "Additional Resources."

Firewood cutting. Many oak woodlands offer wood resources that may be used with minimal damage to most wildlife if cutting is done with an eye toward maintaining habitat values. The overall impact of cutting is affected by the extent and method of wood removal. Some species may benefit by the habitat changes induced by wood cutting, while other species may find the habitat degraded. See the special section on this page for guidelines to aid in planning firewood cutting compatible with wildlife.

Game resources. Managing oak woodland for its game resources is another way landowners can earn income off their land while preserving wildlife habitat. The oak woodland is especially suitable for game ranching, as it is the most important habitat for many of our game species, including deer, quail, wild pigs, band-tailed pigeons, and wild turkeys. All require a diverse woodland with abundant acorn resources, a variety of successional stages, and areas of well-developed shrub understory.

Management for wild pigs deserves special consideration because of the negative impact these animals may have on habitat resources. If you are interested in wild pigs for game or must contend with them on your land, obtain additional management information from listings in "Additional Resources."

Development. Development in the oak woodland creates a number of problems for wildlife. Trees are replaced with structures and exotic vegetation, and remaining habitats are fragmented. The greater the area and density of building, the greater the loss of habitat. In developments, homeowners interested in wildlife must implement landscaping and enhancement



DAVID CAVANARO

Firewood cutting in the oak woodland can be conducted with minimal damage to most wildlife if care is taken to protect the habitat resources wildlife use. In evaluating possible woodcutting projects, consider the available habitats and how selective wood removal would alter them. Indiscriminate firewood cutting tends to remove important wildlife resources such as snags and downed wood, and simplify vegetation structure and composition. These and other adverse effects of woodcutting can be minimized with thoughtful planning. Here are some considerations and guidelines for developing a wildlife-compatible firewood harvesting plan.

- Acorn production differs greatly between trees and between years. Monitor acorn production for at least two years and mark good acorn producing trees. Protect these trees during firewood harvesting.

- Thinning should consider the woodland's long-term regeneration capabilities. This is important to preserve both woodland viability and management options. When cutting, leave seedlings and saplings to ensure replacement. For sustained yield, never remove more wood than can be added by growth. If regeneration is not adequate to maintain the woodland at a given level, either do not cut or supplement natural regeneration with planting.

- Many kinds of wildlife depend on oak snags for food and shelter. Sometimes habitat values may be better maintained by leaving a snag and cutting a living tree instead—though not one that is a prolific acorn producer. Retain at least one snag per acre.

- Zones of vegetation along water courses are especially valuable to wildlife. These riparian zones provide an unusual

diversity of food and cover resources. Be very selective in cutting in riparian areas or, better yet, do not cut at all.

- Wildlife cover is usually reduced by firewood cutting due to direct removal of the trees and removal of associated brush and ground cover. To compensate this loss, use branches of cut trees to construct brush piles for cover. The piles will be used by quail, other small birds, and small mammals for raising young, and for shelter from predators and winter weather.

- Maintain corridors that will enable wildlife to move between blocks of habitat. Especially important are those corridors that connect feeding and watering areas.

- For aesthetic and wildlife values, and to ensure regeneration, maintain a mixed-species and uneven-aged woodland.

—William Tiesje

Acorns are critical to the well-being of many of California's non-game wildlife species. One such species is the scrub jay. Scrub jays are common, year-long residents of conifer, chaparral, and oak woodland habitats. They prefer open woodlands and shrubby areas, especially those with oaks.

HABITAT REQUIREMENTS

Food. Scrub jays eat primarily acorns, seeds, fruits, and insects. They pick food from the ground, foliage, bark, and wood. Occasionally lizards, frogs, and snails are also eaten. Scrub jays have been observed picking and caching up to 400 acorns an hour from valley oaks. One study found that a single scrub jay may "plant" up to 7,000 acorns a year — one at a time into a crevice or hole in the ground. Only a portion of these are retrieved and eaten by the jays. The rest are eaten by other animals or insects, or left to germinate. Obviously, scrub jays are important to oak regeneration. Considering that scrub jays are found throughout most of California's eight million acres of oak woodlands, these birds may collectively "plant" billions of acorns a year!



"MOOSE" HETLBERG

Cover. Scrub jays need a mix of woodland, shrubland, and open areas. Riparian areas may also be important components of the habitat, especially in urban areas.

Water. One researcher has observed scrub jays making daily visits to a spring, suggesting that an open source of free-flowing water may be an important habitat asset.

MANAGEMENT SUGGESTIONS

- *Maintain good acorn-producing trees.*
- *Manage livestock grazing to leave understory vegetation jays can use for food and shelter.*
- *Controlled burning in decadent areas of oak woodland and chaparral may promote shrub sprouting, increasing food and shelter resources.*

—William Tietje

measures that will attract wildlife from adjacent areas.

Wildlife benefit whenever the direct loss of habitat, or the degradation and fragmentation of habitat, is reduced. Larger parcel size and lower building density may help preserve habitat quality, and development plans can include strategies to maintain intact blocks of high-quality habitat. Techniques like cluster development, for example, often leave large areas of open space that are valuable to wildlife. Open space plans, open space or wildlife easements, wildlife corridors, and riparian habitat protection zones can go a long way toward preserving and, perhaps, even enhancing regional wildlife resources in the face of development.

Landowners should also be aware that development can affect habitat quality beyond the confines of a "yard." Landscaping with exotic plants and noise from houses, for example, may drive animals away and contribute to the habitat fragmentation problems already discussed. Domestic pets also affect wildlife; dogs and cats often roam into surrounding natural habitats and may discourage wildlife use in these areas.

CONCLUSION

As a landowner, you make many management choices that inevitably affect nearby wildlife. Decisions regarding how you use the land, how it is landscaped, the number of domestic animals, and even the size and number of buildings, all affect the habitats that wildlife use. The choices you make control how much wildlife are invited onto your land or into your living area, how close they are encouraged to come, and how likely they are to stay. As in all management, your choices involve compromise, and only you can decide which compromises are to be made on your property. Our goal in producing this brochure is to provide you with information and ideas for the decisions you make in managing wildlife among your oaks.

*Designed by Seventeenth Street Studios
Reviewed by Bill Block, Lee Fitzhugh,
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Rick Standiford and Glen Wilcox.*

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ADDITIONAL RESOURCES

Landowners have a number of resources at their disposal for assistance and additional information. A few of these are.

PUBLIC AGENCIES

California Department of Fish and Game, 1416 9th Street, Sacramento, CA, 95814. (Five regional offices: Redding, Rancho Cordova, Yountville, Fresno, Long Beach); (916) 658-7664.

California Department of Forestry and Fire Protection, 1416 9th Street, Sacramento, CA, 95814; (916) 658-5121.

U.S.D.A. Soil Conservation Service, 2121—C 2nd Street Suite 102, Davis, CA, 95616; (916) 449-2800.

University of California Cooperative Extension, Integrated Hardwood Range Management Program, 160 Mulford Hall, Berkeley, CA, 94720; (510) 643-5428.

PRIVATE SECTOR ORGANIZATIONS

California Wildlife Unlimited, UCI Box 19, Coalinga CA, 93210; (408) 385-3741. (A nonprofit organization of landowners "Ranching for Wildlife.")

National Wildlife Federation, 1412 16th Street, N.W., Washington, D.C., 20036-2266; (202) 797-6800.

Private wildlife consultants. For a list write: Wildlife Extension, University of California, Davis, CA, 95616; (916) 752-1496.

The Nature Conservancy, 785 Market Street, San Francisco, CA, 94103; (415) 777-0487.

NEWSLETTERS AND JOURNALS

Oaks n Folks. Integrated Hardwood Range Management Program, Cooperative Extension, University of California, 160 Mulford Hall, Berkeley, CA, 94720.

Outdoor California. Department of Fish and Game, Box 15087, Sacramento, CA, 95851-0087.

PUBLICATIONS

Defenders of Wildlife, 1989, *Preserving Communities & Corridors*, 1244 Nineteenth Street NW, Washington, D.C. 20036.

CALIFORNIA SPOTTED OWL

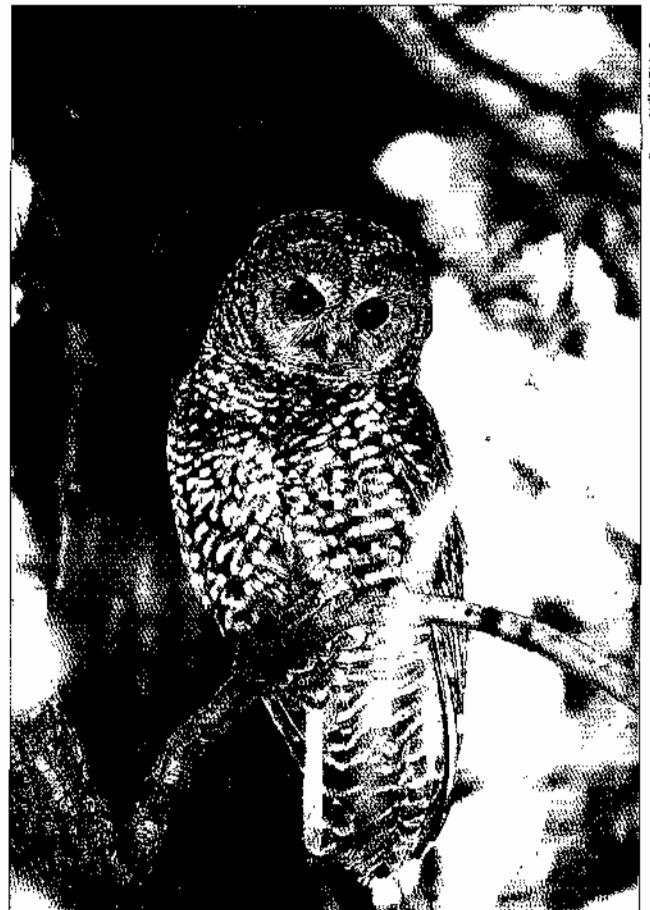
Three subspecies of spotted owls occur in Western

North America. The Northern spotted owl inhabits conifer-dominated habitats, primarily in the north coast ranges into British Columbia. Its southern relative, the Mexican spotted owl, occurs in some wooded areas of the arid southwestern U.S. and Mexico. The California spotted owl utilizes both conifer forests and oak woodland habitats of the Sierra Nevada and the coastal mountains from San Diego County north to San Mateo County. The habitat needs of the California spotted owl are not yet well understood. Observations have shown, however, that this owl often uses the oak woodland throughout the year, relying primarily on heavily wooded sites in riparian areas.

HABITAT REQUIREMENTS

Food. The California spotted owl feeds primarily on small mammals including woodrats, mice, birds, bats, reptiles, and large arthropods.

Water. Open water appears to be an important component of spotted owl habitat. They often hunt near small pools which attract their prey.



PHOTOGRAPH BY PETERSON

Cover. California spotted owls apparently require large trees and at least a 70 percent canopy cover for nesting and shelter. The shade provided by these dense forests may be important in protecting these birds from extreme summer heat. In the oak woodland, the California spotted owl is nearly always associated with oak riparian habitats, often those containing large live oaks, blue oaks, the California bay, and sometimes California sycamore and cottonwood.

MANAGEMENT SUGGESTIONS

- Maintain riparian habitats and manage for a dense canopy cover.
- Maintain large trees in riparian areas for nesting and roost sites.
- Encourage natural regeneration or plant new trees in riparian areas. Protect seedlings and saplings from wildlife or livestock damage.
- When possible, manage water supplies to maintain stream flow.

—William Tietje
and George Steger

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- Numerous other publications of interest to rural landowners are available from the
- Agricultural Publications Catalog
University of California,
Agricultural and Natural Resources
6701 San Pablo Avenue,
Oakland, CA 94608-1259.

SHARON G. JOHNSON

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