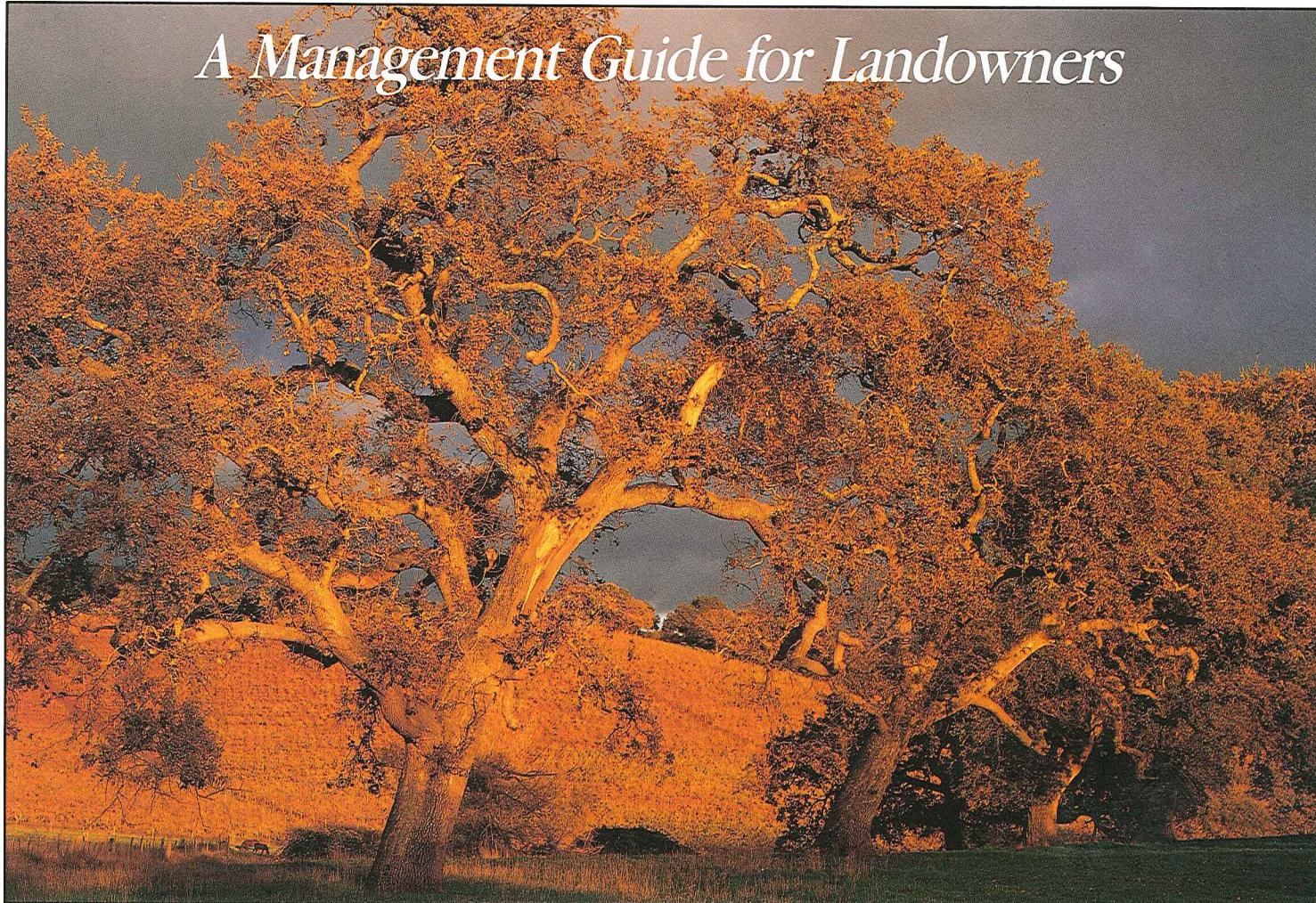


LIVING AMONG THE OAKS

A Management Guide for Landowners

LARRY ULRICH



What is more characteristic of the California landscape than the oak? Round-crowned oaks dapple the rolling hills, solitary monarchs shade our rural roads, and valley giants stretch skyward in banners of leaves and lichen. Both past and present-day travelers have stopped in awe of our native oaks, and countless photographs and memories are framed by their spreading, weather-worn branches. The oak is particularly emblematic of the inland regions of California, where scattered oaks, rolling pasture, and distant cattle are the common elements of an infinitely variable landscape.

In this region—often called the hardwood range by land managers—the vistas of oaks, pasture, and cattle bestow a tranquility that sometimes belies the fourth element—people. Like the earliest Californians, humans today come to the oaks for food, shelter, and beauty. As we appreciate the beauty of oak landscapes, we fatten our flocks on their bounty, and seek homesites in their shadows. But intensifying land use in the hardwood range has brought soil erosion, reduced forage production, poor regeneration among some species of oaks, and dwindling resources, due to development. Today the hardwood range clearly shows signs of the last hundred years of human habitation.

All Californians can assist in the protection and enhancement of native oak resources, but none are in a better position to do so than landowners in the hardwood range. These individuals shape the future by their decisions, which cumulatively direct the management and land use of more than seven million acres of California's oaks and pasture.

This brochure is designed for you—the landowner. It brings together a variety of current information about living and making a living among the oaks. The University of California Cooperative Extension hopes that you will find this information useful as you manage your land and make decisions that shape the future of your oaks.

Needs and Conflicts

In designing and building homes, workspaces, storage areas, gardens, orchards, and places for animals, your decisions are shaped by your over-all objectives for your land. Managing land as a residential site, for animal production, for wild or park-like qualities, all may require different actions. As you choose management objectives for your land and evaluate its suitability, also consider the oaks on those sites and whether your objectives are compatible with the basic needs of the trees. Careful planning and design can often provide benefits for both people and oaks.

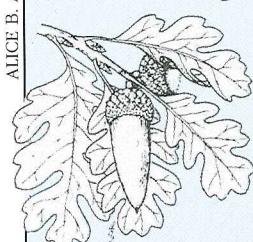
Past development among the oaks has revealed specific areas of conflict. Various construction practices seriously injure oaks or inadvertently kill them, increasing fire hazards and creating liability and management problems. Gardening practices such as amending the soil, planting lawns, or irrigating under established oaks will kill them. Domestic animals and wildlife, as well as insect and fungus pests, also take their toll. In combination these elements can present formidable obstacles to the survival of mature oak trees. Harmful effects can be minimized, however, by thoughtful management practices.

OAKS GIVE US:

- Shade & Shelter
- Increased Property Values
- Beautiful Carefree Landscapes
- Food & Fuel

Oaks of the Hardwood Range

ALICE B. ADDICOTT



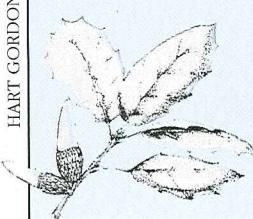
Valley oak, (*Q. lobata*)

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, especially in valley bottoms and on deep alluvial soils.



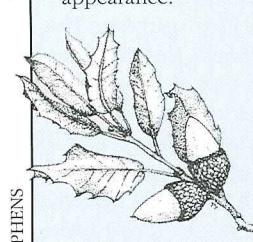
Blue oak, (*Q. douglasii*)

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, but oak occupies the more shallow soils, steeper slope, and upland sites.



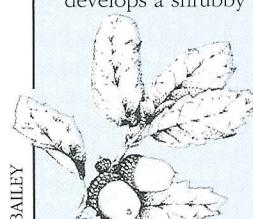
Coast live oak (*Q. agrifolia*)

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 (*Quercus 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 generally found in more heavily wooded sites than the blue oak, and in chaparral habitats or other dry locations it often develops a shrubby 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.

COURTESY OF THE UC DAVIS ARBORETUM

LIVING AMONG THE

Building Around Oaks: The Hazard Zone—Where the Roots Are

Young, native oaks are tolerant of environmental changes and will usually adapt to landscaping practices. But as oaks mature, their environmental tolerances become set and changes can weaken or kill them. A mature oak, for example, is well adapted to California's naturally dry summer weather. If the environment of an adult tree is changed by the introduction of summer watering—for gardens, lawns, or improved pasture—fungi will proliferate on its roots and begin to kill it. Unfortunately, there may be few visible signs of a fungus attack before it is too late (See "Oaks in the Home Garden"). On the other hand, a young tree on well-drained soils, raised under a regime of summer watering, maintains some resistance to threatening fungi even into adulthood.

The most vulnerable parts of a mature tree are the root crown (at the base of the trunk) and the entire root zone. Oak roots are relatively shallow and extend from the root crown outward, reaching some distance beyond the tree's drip line (the outermost edge of a tree's foliage). For management purposes, think of a tree's root zone as being one third larger than the drip line area. Ideally there should be no disturbance within this zone. This means no grading, digging, trenching, covering the ground with asphalt or concrete, or landscaping with plants that require summer watering (see "Oaks in the Home Garden"). Even excessive foot traffic, operating heavy equipment, and parking vehicles (particularly heavy ones) should be avoided.

Think of the root zone as the tree's "home"—the minimum ground required for its survival. The best way to live with a mature oak is to leave it and the area beneath its canopy alone. Establish a mini-park, if possible, for birds and other wildlife, and keep it dry. If modifications are unavoidable, strive to keep the root zone area in as natural a condition as possible, and keep ground disturbance as far away from a tree's trunk as possible.

Threats To The Root Zone

A mature oak is accustomed to a certain balance of moisture, air, soil temperature, and nutrients. A change in these factors can severely alter conditions for the tree. The most common human activities that alter a tree's root environment are:

Changes in grade. This includes any changes in the ground level under the tree, either by mounding up soil or excavating it. Excavating soil can destroy the roots and expose them to damage by surface activities. Mounding up soil reduces the oxygen supply to the root zone, which can suffocate a tree. Depending on climate and soil moisture, additions of soil can also encourage root rot.

**Construction
DANGER:
Proceed with
CAUTION**

Changes in drainage. Changes in the drainage around an oak can put water into the root zone during the season when soil temperatures are high and oaks need to be dry. Saturated soils inhibit the exchange of oxygen in the root zone and encourage the proliferation of soil-borne diseases.

Soil compaction. Heavy traffic or the operation of heavy equipment can cause soil compaction, that is, the spaces between the soil particles become compressed. Since a tree "breathes" through the exchange of gasses that occurs within these spaces, compaction will lessen gas exchange, suffocating the tree.

Paving. Paving presents many of the same hazards as soil compaction, and compaction itself often occurs in preparation for and during paving. When the ground is covered with a nonporous material such as asphalt or concrete, the free passage of moisture, air, and other gases within the root zone is impeded. There are porous materials, however, that are more compatible with the oak environment and make excellent ground coverings. Porous brick with sand joints, for example, or gravel, bark, wood, mulches, and many other similar such materials provide an attractive ground covering that permits the free passage of water and air.

Regardless of the permeability of the ground covering, nothing should be placed within a six-foot radius of a tree's trunk—the minimum area that should always be left undisturbed and uncovered.

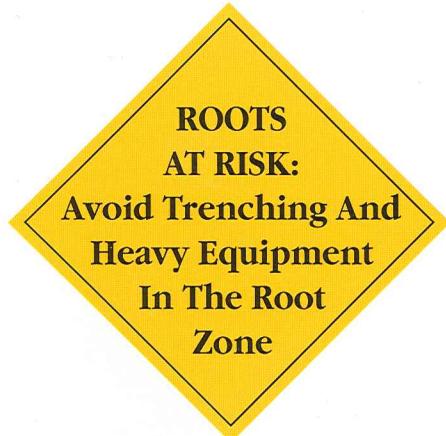
Fills. In general, do not fill within the drip zone of a tree because fills tend to compact the soil and hence reduce permeability.

**Fungus
DANGER:
Don't Water
Mature
Trees**

OAKS

They also promote water entrapment in the root zone, encouraging root and crown rots. Use retaining walls outside of the drip line to protect the natural grade under the tree.

If there is no alternative to filling within the dripline, techniques are available to minimize impact on the tree. Consult an arborist specializing in oaks, or some of the publications listed in "Additional Resources".



Trenching. Trenching is a commonly overlooked cause of tree mortality. When utility trenches are dug into the root zone, major portions of a tree's roots may be cut or severely damaged. When a large proportion of the roots are damaged, trees die. Trenching in the root zone should be avoided whenever possible.

Perhaps the best alternative to trenching is to place utilities in a conduit which is bored through the soil. This eliminates the need for trenching, and the small size of the conduit minimizes root damage.

If utility conduits are unavailable, try to have all utilities placed in a single trench, as multiple trenching by different companies is a common culprit in tree deaths. Convincing utilities to use a single trench may require vigilant lobbying with the various companies, since it is often difficult to coordinate their timing needs and trenching specifications. Persistence pays off, however, and coordination can be accomplished!

After any trenching in the root zone, the tree should be carefully pruned to remove canopy material proportional to the roots lost or damaged. An arborist can best advise on the needs of this pruning.

Disturbance beyond the root zone. Beyond the root zone, mature oaks are usually less affected by landform and drainage changes, soil compaction, paving, fills, and trenching activities. But the indirect effects must still be considered. Watch out for fill materials that could pond water around a tree. Consider the effects of nearby pools on local soil moisture, and watch for bank or hillside cuts that could drain moisture that a tree is used to receiving. Any activity that changes the environment of a mature tree, even indirectly, could threaten its well-being.

Native Plants for Oak Gardens

These are just a few California native plants that can be used in landscaping oak gardens. Once established—usually after a year—they require little care, one monthly watering, and offer beautiful foliage, showy blossoms, and sometimes, pleasant fragrances.

Shrubs Partial Shade

Carpenteria californica, Carpenteria
Ceanothus species: Wild lilacs
C. griseus, *C. thyrsiflorus*, *C. maritimus*,
 plus cultivars: *C. Joyce Coulter*, *C. Ray Hartman*.
Cercis occidentalis, Western redbud
Cercocarpus betuloides var. *blancheae*,
 Mountain-mahogany
Eriogonum arborescens, Santa Cruz Island
 wild buckwheat
Garrya elliptica, Silk-tassel bush
Heteromeles arbutifolia, Toyon
Mahonia species, Barberries and Mahonias,
M. amplexicaulis, *M. dictyota*, *M. fremontii*,
M. Haematoxarpa, *M. bigginsiae*,
M. pinnata
Prunus ilicifolia, Holly-leaf cherry
Rhamnus californica, Coffeeberry
Ribes species, Gooseberries:
R. aureum var. *gracillimum*, *R. malacatum*,
R. speciosum, *R. sanguinum*, *R. viburnifolium*
Rosa californica, California wild rose
Rosa californica, "Plena" double California
 rose
Salvia clevelandii, San Diego wild sage
Salvia leucophylla, Coastal white sage

Shrubs Full Sun

Fremontodendron californicum mexicanum and cultivars, Fremontia, Flannel bush, "California glory" "Pacific sunset"
Galvestia speciosa, Island snapdragon
Lupinus albifrons, Silver bush lupine
Lupinus chamissonis, Chamisso bush lupin
Mimulus aurantiacus, Bush monkey-flower
Mimulus pumiceus, Red monkeyflower
Penstemon clevelandii, Cleveland's penstemon and other species
Romneya coulteri, Matilija poppy

Ground Covers

Baccharis pilularis subsp. *pilularis*, Dwarf coyote bush
Ceanothus griseus var. *horizontalis*, Carmel creeper
Ceanothus maritimus, Hoover ceanothus
Ribes viburnifolium, Catalina currant

Evergreen Herbaceous Plants

Dryopteris arguta, Wood fern
Eriogonum umbellatum var. *polyanthum*, Buckwheat
Heuchera maxima, Giant alum root
Iris douglasiana and hybrids
Viguiera deltoidea var. *parishii*

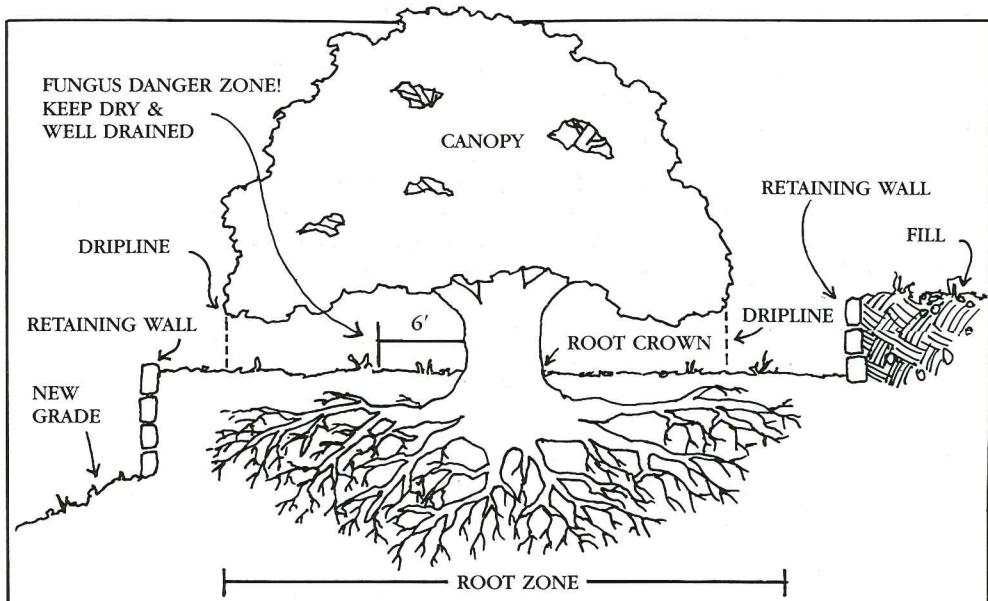
Deciduous or Annual Herbaceous Plants

Clarkia species, Clarkias
Collomia species, Chinese houses
Dodecatheon clevelandii, Shooting stars
Eschscholzia species, Poppies
Montia perfoliata, miners lettuce
Nemophila Menziesii, Baby blue eyes
Oenothera species, Evening Primroses
Sisyrinchium bellum, Blue-eyed-grass
Viola pedunculata, Yellow pansy
Zauschneria californica, California wild fuchsia

Bulbs

Brodiaea species and related genera:
Dichelostemma pulchellum
Tritelia laxa
Calochortus species, Mariposa lilies
Chlorogalum pomeridianum, Soap plant
Lilium pardalinum, Leopard lily
Trillium chloropetalum, Common trillium

For more information about these and other California native plants compatible with oak gardens, contact local arboreums, botanical gardens, and the California Native Plant Society (see "Additional Resources").



OAKS IN THE HOME GARDEN

Oaks can prosper in close proximity to human habitation if care is taken to preserve the basic elements of the natural oak environment. Garden settings include many of the building hazards discussed above, but there are several more considerations. If the needs and limitations of mature oaks are not part of gardening design and procedures, well-meaning people can make serious mistakes.

Care and Feeding of Mature Oaks

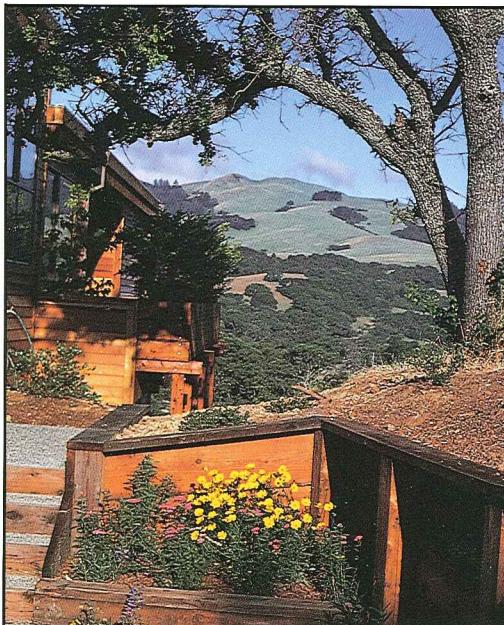
In approaching the design and care of your oak garden, periodically evaluate the health of your oaks. The information in "Oak Health Check" (see right) should help you with this. If problems are evident, consult the references at the end of this brochure or an arborist specializing in oaks. If your oaks pass their health check, they will not need a lot of attention from you as long as care is taken to preserve the basic elements of their environment. The following information can guide your care of mature, healthy oaks.

Pruning. Mature oaks do not require pruning except to remove dead, weakened, diseased, or dangerous branches. Sometimes a light thinning, called "daylighting", of 10 to 20 percent of the leaf area from branches three to six inches in diameter can benefit a tree by opening its canopy to deeper light penetration. This also reduces wind resistance and the weight of branches. Avoid excessive pruning, however, as it stimulates vigorous sprouting that is highly vulnerable to damage from mildew.

Light pruning can be done at any time of the year. Heavy pruning, however, should be made during the dormant period (winter) on deciduous oaks and during July and August on evergreen trees. The most important factor in pruning is to make all cuts correctly. Avoid leaving branch stubs and do not paint cuts. For more advice consult an arborist or recent publications on pruning techniques.

Watering. Mature oaks in wildland settings are adapted to dry, summer conditions. Summer irrigation will doom the adult tree (see "Diseases") and is to be avoided, especially near the base of the tree. Do not water even ornamentals planted under oaks. If they need watering they do not belong there (see "Oaks in the Home Garden"). If the winter season is unusually dry, a supplemental watering in the early spring, can complement natural rainfall. Water deeply in the outer two-thirds of the root zone. A similar watering can be repeated once or twice during especially dry summers.

Feeding. A healthy, mature oak under natural conditions does not require supplemental feeding. But when the oak exhibits disease or stress, or when growth is poor and its natural fertilizer supply (the leaf drop and organic litter that decomposes under the canopy) is removed, supplemental feeding can be beneficial. Young oaks can be fertilized to encourage rapid growth.

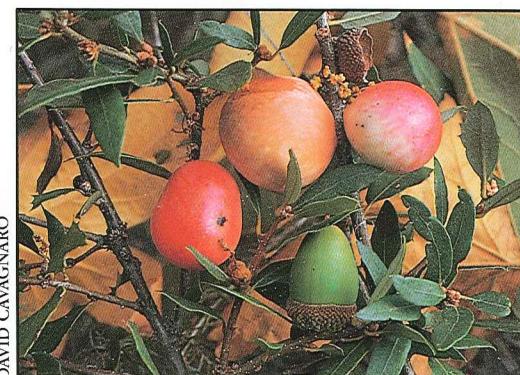


COMPATIBLE BUILDING AROUND OAKS PROTECTS A TREE'S ROOT ZONE.

their water requirements and fungus problems, but also because the thick root mats of such ground covers inhibit the exchange of air and moisture that a mature tree requires.

Many attractive native plants are well suited to the natural oak environment and, when incorporated into oak landscapes, will provide beautiful, low maintenance, irrigation-free gardens. The California Native Plant Society can provide excellent information on landscaping with native plants (see "Additional Resources"). In addition, the University of California has developed some strains of drought-tolerant, shade-tolerant grasses that could be used under an oak in the outer portions of its drip-line area.

In all cases of planting under oaks, the zone within six feet of the trunk should be disturbed as little as possible. If care is taken to keep the base of the tree dry, some native plants, as well as mulches or porous ground coverings such as gravel, brick with sand joints, and wooden decking (built on concrete piers rather than on poured foundations), can be used in this sensitive area.



COLORFUL GALLS, CAUSED BY GALL WASPS, ARE COMMON ON TWIGS, BRANCHES, AND LEAVES.

Fire Safety Considerations

The threat of wildfire exists throughout all oak-inhabited regions of California. Oaks are fairly resilient when burned and will usually resprout at the base of the tree, where branches join the trunk, or in the forks of branches.

Oaks can also be readily incorporated into the fire-resistant landscaping needed around homes and buildings. Local fire fighting agencies require clearance zones around buildings (usually 30 feet) where brush must be removed and dry, highly flammable vegetation must be reduced. Since oaks cannot tolerate lawn coverings or summer watering, porous ground coverings can be used under mature oaks to retard the growth of flammable weeds (see "Threats to the Root Zone—Paving"). Organic debris should be cleared and branches should be pruned and kept from touching the ground or hanging over buildings. This reduces the dangers of ground fires spreading into tree canopies or onto roofs.

Dependable water sources, such as water

COMPATIBLE GARDENING BENEATH OAKS

Since mature oaks will not tolerate summer watering, care must be taken to select landscaping components that are in harmony with the established oak environment. Thick ground coverings of lawn, ferns, ivy, or any other vegetation requiring watering are inappropriate under oaks, not only because of

impoundments, swimming pools or water tanks (located away from mature oaks), greatly improve fire-fighting resources on any piece of land. For guidance always consult the clearance regulations of local fire-fighting agencies.

Diseases and Infestations

Oaks in natural conditions are relatively free from disease. But when compromised by soil compaction, changes in soil moisture, or other disturbances, trees become weakened and have difficulty fending off their natural enemies. Often by the time the symptoms appear the tree is in crisis, and remedies may be too late. An arborist or Cooperative Extension Advisor should be called when the following symptoms are noticed:

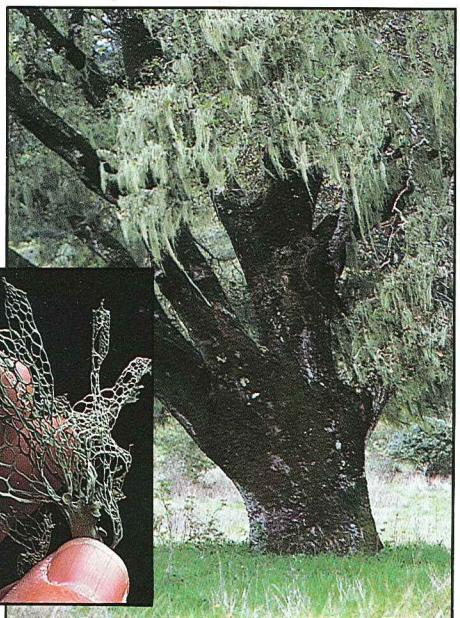
—Loss of tree vigor, twig die-back and wilting, abnormally yellowish leaves, and wounds on the bark that ooze rusty-looking fluid. These symptoms accompany crown rot (*Phytophthora* and *Pythium* spp.).

—Die-back of branches, emergence of clumps of honey-colored mushrooms at or near the base of the tree in the late summer or fall; often accompanied by a white fan-like fungus growth between the bark and sapwood and black shoestring-like rhizomorphs in the soil. These symptoms accompany the oak root fungus, *Armillaria meleae*.

Armillaria meleae is usually present on the roots of all oaks, even when the fungus is not visible. Under natural conditions it is held in check by summer drought. Once a serious infestation develops on the roots of a tree, however, the fungus can persist in the soil organic material and can later infect other trees—even after death and removal of the host tree. Fruit trees and ornamentals planted on the site, particularly those that are irrigated during the summer, may be subject to infestations.

—Another, less common fungus infestation, called "heart rot," occurs when one or several fungi attack the inactive heartwood of an oak. This does not usually impair the

Coast live oak laden with Spanish moss.



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tree's vigor but can weaken it structurally. Weakened branches will break off, and a weakened trunk may not be able to support the crown during a wind storm. Regular examination of the tree and judicious pruning and bracing where needed can prolong the life of an afflicted oak.

Mistletoe. This parasitic shrub grows in the branches of many oaks and can cause structural weaknesses that make a tree more vulnerable to branch breakage. Small infestations can be controlled by cutting out the mistletoe, and cutting back the oak's bark around the spot where the mistletoe stem entered the oak branch. Major infestations are difficult to control, however, and a Cooperative Extension Advisor or an arborist specializing in oaks should be consulted.

Spanish Moss. Spanish moss is actually a lichen, rather than a moss, and since it is not parasitic it generally offers little threat to oaks. Growth may be slightly reduced due to shading of many leaves in a tree heavily laden with Spanish moss. But the situation is not life-threatening and is easily alleviated by judicious pruning.

Insect pests. Innumerable insects find their livelihoods in the branches and leaves of the oaks, usually without much consequence to the healthy tree. The oak gall, for example, is a harmless swelling of branchlets in reaction to enzymes released where a wasp lays its eggs. These galls can be so abundant, colorful, and multi-formed that they resemble dangling Christmas ornaments.

There are some insect infestation however, like pit scales (appearing as pinhead-size scales on the bark of twigs and branchlets), oak moth, and other leaf-eating infestations, that can cause serious damage to oaks. Whenever a severe insect attack causes substantial leaf loss, changes in leaf color, twig die-back, sooty foliage and branches, or other significant changes in appearance, intervention may be required. University of California Cooperative Extension has several publications on diagnosis and treatment of insect infestations (see "Additional Resources"). Farm Advisors and arborists can also provide needed information.

Animal pests. In most cases animals pose little problem to the mature oak. Browsing or grazing animals may inhibit natural regeneration but rarely threaten the mature tree. There have been cases, however, where populations of ground squirrels or other ground-dwelling rodents have caused serious damage to oaks. Take measures to control these populations if oak vigor is diminished or if there is extensive excavation by animals in the root zone.

Other Diseases. The health and vigor of oaks can also be compromised by a number of other afflictions that are not discussed here. Since 1980, for example, die-back and decline, particularly among coast live oak (*Quercus agrifolia*), has been observed in wide-spread areas of California. Several fungi may be involved in this condition and treatments are still experimental. Whenever you notice serious, unexplained decline in your oaks, contact an arborist or a Cooperative Extension Advisor for information and advice.

Oak Health Check

Check for tree growth:

- Tree size is not a good indicator of growth. Oaks on steep, less watered sites may be smaller but still healthy.
- Twig growth for the season can vary from 3 to 24 inches or more in length. If twig growth is less each year, the tree may be declining.
- Look for growth cracks on a tree's trunk. Cracks appear as widening fissures on existing bark. Tissue in the cracks should be bright green or pink when scratched. Loose bark indicates dead tissue and a diseased condition.

Check for pests and stress:

- Watch for disease or insect infestations indicated by leaf loss, changes in leaf color, twig die-back, sooty foliage and branches, or other significant changes in appearance.
- Watch for unusual leaf drop during the early summer, particularly among the older leaves. This can be an indication of drought stress, nutrient deficiencies or other root zone problems.
- Watch for twig and branch die-back from the ends of branches. This can be an indication of disease, root loss and/or other root zone problems.
- Watch for emergence of clumps of honey-colored mushrooms at or near the base of a tree in the fall and early winter. These are often accompanied by a white fan-like fungal growth between the bark and sapwood. These symptoms accompany the oak root fungus, *Armillaria meleae*.
- Watch for mistletoe, a parasitic, broad-leaved shrub that grows in the branches of many oaks.
- Watch for other changes of tree appearance that may indicate declining health.

Check for structural weakness:

- Watch for developing structural weaknesses caused by mistletoe, heavy foliage or poor branch structure. Tight, V-shaped branch crotches, long horizontal limbs, extensive decay in branches, and cracks developing in crotches are all indications of weak branch structure. Have tree pruned or support branches to prevent further breakage.

Check for poor drainage:

- Standing water should not be evident within a tree's root zone.
- Building, landscaping, or other activities near oaks should not increase water in the root zone during the summer.

Check the root crown condition by digging carefully at the base of the tree:

- A characteristic root flare should be obvious. If not, the trunk has been buried and soil should be excavated to the original grade.
- Bright pink, green or dark red bark tissue is healthy. Dark yellow or brown tissue underneath the bark indicates disease.
- Large decay pockets at the root crown or in the buttress roots may indicate a dangerous condition.

Consult a U.C. Cooperative Extension Advisor, an arborist specializing in oaks, or "Additional Resources" for guidance in dealing with problems you may find.

MANAGING AND ENHANCING

Historically, livestock grazing and wildlife production have been the dominant land use throughout the hardwood range. We can thank the livestock industry for the open, pastoral character of much of California's countryside. But it is also in portions of this region that regeneration for several oak species has been poor, especially during the last 80 years. Cattle are the oft-named culprits, and although it is true that cattle do take their toll on the oaks by consuming acorns, seedlings, and saplings, oaks often do not regenerate even when the cattle are taken off the land. Obviously, the oak regeneration problem is more complex.

It has been suggested that grazing for the last hundred years has caused a combination



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of ecological reactions that are inhibiting natural oak regeneration. Such factors as changes in the species composition of the grassland, greater ground squirrel populations, insect and soil fauna changes, and alterations in populations of acorn and seedling eaters may all complicate oak regeneration. Whatever the causes, careful management is needed—of both land and oaks—if these trees are to continue their traditional and ecological role on the hardwood range.

In managing land, animals, plants, and other property resources, there are many things landowners can do to encourage healthy, vigorous oak populations. Some basic management considerations are discussed in the following section. But, in making management decisions that affect oaks, your greatest guidance will probably come from your own observations. Oaks and ecological settings vary tremendously from place to place, as does the relevance of management concepts. So before making decisions, study what actually takes place on your land. Experiment if you want to—you may discover techniques that could also be useful to other landowners.

Grazing Animals and Oaks

Minimizing direct impact on existing trees. Watch your trees for signs of animal damage. Take care that the number of animals congregating under trees does not cause excessive soil compaction, expose the root crown at the base of the trunk, or expose surface roots. Also watch for excessive chewing on the tree trunk. Animals can kill a tree

by girdling if they chew around the tree, through the bark, and into living wood. These types of problems are of particular concern in paddocks or pastures where animals are concentrated.

Measures such as reducing numbers of stock, alternating pastures in use, installing exclosures, screens, or other protective devices to keep animals away from sensitive or damaged areas, can alleviate problems. If damage is severe, you may want to consult an arborist for remedial treatments.

Pasture management. In managing your pastures, always remember the general prohibition against summer watering of oaks. If your pastures are improved by summer irrigation, adjust irrigation devices to apply water outside of the root zone only. Adjusting watering schedules to infrequent but long periods of irrigation will also reduce stress on oaks. Always try to keep the base of the tree dry (see "Oaks in the Home Garden"). Observe the location of watering devices and other water sources to make sure that the area beneath an oak's canopy does not become wet from leaky water lines, valves, holding tanks, or from animals splashing in troughs.

Experiments to Encourage Natural Oak Regeneration

This is currently an area of considerable experimentation and few results—in part because it takes a long time to obtain results from trees that live many years. But if you have the interest and flexibility in your management needs, you might experiment to encourage greater natural oak regeneration on your land. Do not count on high success rates, however, since other, unknown factors may be limiting the oaks.

Promising sites. Areas particularly favorable to natural regeneration include north-facing slopes, regions with an annual precipitation greater than ten inches, deep soils, alluvial sites, swales, or other places with subsurface water. The absence of large numbers of seedling, sapling, or acorn eaters, like ground squirrels, deer, or feral pigs will also improve seedling survival.

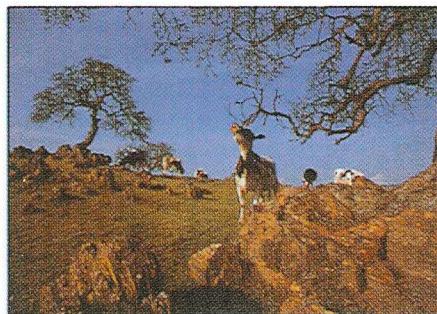
Because seedling mortality is usually high, regeneration possibilities are best in areas that can remain free from grazing animals for a number of years, and where several mature trees provide acorns. Small groves or clusters of trees could provide such sites. Sites offering some natural protection, such as rocky or shrubby areas that naturally exclude or impede the movements of deer or livestock may also be favorable.

Techniques. A number of techniques can be employed to encourage natural regeneration:

- 1) Create fenced areas, called exclosures, that protect seedlings from animals. Exclosures can be small enough to protect single

seedlings or large enough to accommodate entire groves. They are designed to exclude specific animals. For example, some of the smaller exclosures can keep out birds and ground-burrowing animals. You can design appropriate exclosures yourself, look at examples on this page, or refer to the references in this brochure for ideas.

- 2) Experiment with seasons of grazing, as well as duration and numbers of animals in areas where seedlings or saplings are present. These may be in areas where you have employed exclosures or in areas where regeneration is occurring naturally. Cattle may avoid oak leaves when other forage is abundant. Oak seedlings and saplings can also resprout after being grazed.



DAVID CAVAGNARO

Helping Nature—Propagation and Planting

Propagation and planting are rewarding ways to speed up nature's processes, beautify your home site, or even enhance the woodland on more remote parts of your property. Your investment for propagation activities can vary according to the time and money you want to spend. Both simple and elaborate efforts have proved successful. Site factors such as soil moisture, predators, weather, and luck are important in propagation success, and these are often hard to evaluate.

Seed and seedling sources. Regardless of whether you are planting acorns you collect or seedlings raised elsewhere (by native plant nurseries, youth groups, or service clubs, for example), an effort should be made to use local seeds for all wildland planting. Scientists believe that local ecotypes, or strains of species, have evolved in response to local conditions and are therefore best adapted for survival.

Collecting acorns. Most acorns ripen from late October to early November, with seeds on the lower branches ripening first. Use tools, such as long-handled loppers, or sticks to knock them down. Fully mature acorns will dislodge easier than green ones, but birds, deer, and insects will quickly take their toll if acorns are not collected soon after ripening. The biggest acorns are usually best. Test by soaking them in a pail of water, keeping only sinkers. Acorns that float often have been damaged by insects or have not matured properly. But if acorns were collected off the

OAK RESOURCES

ground where they may have dried out, soak them longer—up to 24 hours—before discarding floaters.

Storing acorns. Acorns may be stored up to six months without significant loss in viability if they are kept cool and not allowed to dry out. Place them in peat or saw dust within polyethylene bags, in an environment with temperatures around 40 degrees Fahrenheit, such as in a refrigerator. Polyethylene bags with a wall thickness of four to ten mils are ideal for storing acorns since they are permeable to carbon dioxide and oxygen but impermeable to moisture—two factors that help maintain acorn viability.

Preparation for planting. Float the acorns again, and select the sinkers.

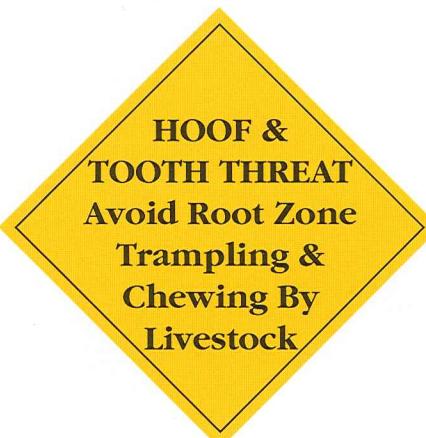
Planting directly in the field. Direct planting of acorns eliminates the root disturbance that occurs with transplanting and allows maximum root development. Methods for planting vary tremendously, so feel free to experiment. Additional information on planting can be found in other Cooperative Extension publications (see "Additional Resources").

Select a site with good drainage. Plant in the late fall or early winter when acorns will be well-watered by the rains. Dig a hole ten inches in diameter and four to five inches deep. Break apart hard or compacted soil with a shovel. Place one gram of nitrogen fertilizer in the bottom of the hole and replace the soil, tamping it down and leaving a one to three inch depression at the top. Remove acorn caps and place six to ten acorns, tips down or sideways, in the hole. Cover with remaining material and tamp down. Use some protective device (see illustration) to exclude both above and below-ground predators. Keep the soil covered with mulch and weed when

necessary. Thin seedlings to two or three at the end of the first season and one by the third year.

If the site is on a steep slope, cut into the hillside to create a pocket for the seed. Plant the acorns on the lip of the pocket with the cut sloping slightly downward and deeper into the hillside (see illustration of exclosures). This acts to reduce erosion and collect moisture for the seedling. It also keeps the seedling out of the seasonally-saturated soil at the back of the cut.

If acorns are planted after heavy rains when soils are moist, watering is not needed. Otherwise, water thoroughly after planting. Periodic watering during the first several sum-

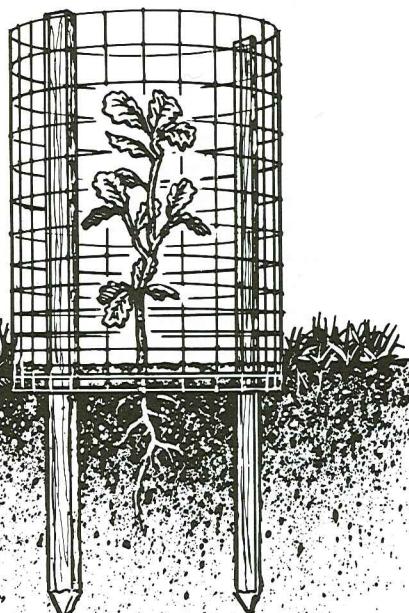


mers will increase seedling survival. Good sites may only need watering two or three times the first year, but dry conditions in poor or sandy soils may require watering as often as once a week. Always soak the soil thoroughly to stimulate root development, and allow the surface to dry between waterings. Taper off watering during the second and third year.

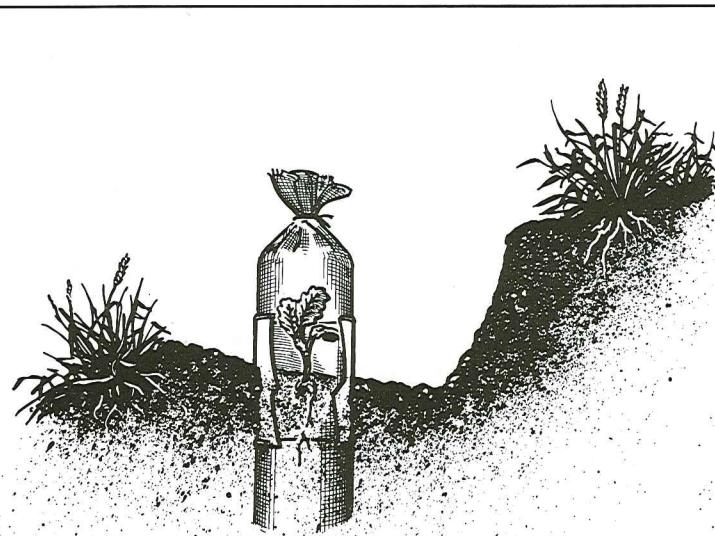
Planting into cans. Plant acorns in loose potting soil in one-gallon cans or deeper containers (because the tap root grows quickly, depth of containers, not width, is important). Containers should have holes in the bottom to allow for drainage. Place acorns on their sides at a depth of one half to one times the width of the acorn. Keep the soil moist but aerated.

Transplanting. If possible, seedlings should be transplanted as soon as the first leaves open and become firm, before extensive root development occurs. Young trees in containers should be transplanted in the late winter or early spring, after the ground has begun to warm and before the leaves of deciduous trees begin to emerge. The hole should be twice as wide and deep as the can. Thoroughly wet the root ball in the can. Carefully remove the root ball. If roots have begun to curve around the inside of the container, prune them to allow placement in the hole without bending or folding. Prune a corresponding amount of foliage after transplanting. Gently set the root ball in the hole with the root crown at the level of the soil surface. Fill the hole with soil, firmly tamp and soak.

Watering transplanted oaks. Watering, weeding, and mulching is important until the seedling is well established. If transplanting is done during the fall or winter, normal rains should be adequate until the dry season. For the first season, thoroughly soak seedlings so that water deeply penetrates the soil every two weeks or whenever the top two inches of soil is dry. Taper off as trees become established—many plantings are successful with only several supplemental waterings during the first season. If the transplant is to live in an irrigated environment make sure the area around the root crown is adequately drained.



Two frequently used exclosure devices designed to protect seedlings from ground squirrels, birds, and deer.



ENHANCING PROPERTY

Wildlife Enhancement

Oak environments are among California's richest wildlife habitats; 110 species of birds use oak habitats during the breeding season, and 35 percent of California's land mammals utilize oaks during some time of their lives. California's deer herds are particularly dependent on oak habitats. By maintaining the health of your oak woodland, you also maintain an abundance and diversity of native wildlife.

Aside from reducing oak seedling and sapling survival, wildlife do not harm oaks, and instead provide benefits through maintaining ecological balances. Some birds and mammals even "plant" acorns during their foraging activities. The presence of wildlife often adds beauty to a woodland and value to property. When desired, landowners can take some measures to increase the abundance and diversity of wildlife on their lands. Here are a few suggestions.

Leave brush piles in areas where they do not pose a fire hazard. These environments are used by quail for cover and by a variety of small animals for food and shelter.

Leave a few snags if they do not pose a fire hazard or safety concerns. Snags—dead, standing trees—are often rich environments for wildlife, especially birds. Woodpeckers and other cavity-nesting birds rely on these habitats, and predatory birds use snags as perches. Many birds will move acorns, inadvertently distributing them to new germination sites.

Add water impoundments (well away from oaks). Not only does year-round water increase wildlife diversity, it also improves fire-fighting capabilities.

Manage vegetation for diversity. The diversity of wildlife depends upon the diversity

of habitats and age classes of vegetation. If you maintain grassland, oak woodland, shrubland, as well as diverse gradations between these vegetation types, you will encourage diversity in wildlife occupants. The edges between these zones are particularly rich in wildlife. For example, if you allow a field to become shrubby on the edges where it borders shrubland or woodland, you will be inviting deer, quail and other animals.

Thinning

Individual oaks and groves of oaks can be thinned to meet many landowner needs. Thinning can increase tree growth, stimulate young trees, produce firewood, encourage wildlife, provide forage for livestock, and improve fire safety, while maintaining or even enhancing the oak ecosystem. The degree of thinning and trees selected depend upon the nature of the woodland and the objectives of the landowner. Assistance in designing thinning objectives and how to meet them can be obtained from Cooperative Extension, local Resource Conservation Districts, and professional foresters.

Commercial Prospects

Because of the ever-increasing demands of a growing population on dwindling open-space resources, owners of rural and semi-rural lands can use their lands for a variety of commercial ventures. Consider raising Christmas trees, specialty or nursery crops, or mushrooms. You could also open your lands for recreational uses such as camping, hiking, hunting, horseback riding, birdwatching, photography, fishing or mushroom-picking. The references in the bibliography provide further information.

ADDITIONAL RESOURCES

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

Public Agencies:

Univ. of California Cooperative Extension's Integrated Hardwood Range Management Program, 145 Mulford Hall, Berkeley, CA 94720-3114, (510) 643-5429, email: ihrmp@nature.berkeley.edu, <http://danr.ucop.edu/ihrmp/>

California Department of Forestry and Fire Protection, P.O. Box 944246, Sacramento, CA 94244-2460, (916) 653-8007, <http://www.fire.ca.gov>

Department of Fish and Game, 1416 9th Street, Sacramento, CA 95814, (916) 653-7664, <http://www.dfg.ca.gov>

USDA Natural Resources Conservation Service, 430 G Street #4164, Davis, CA 95616-4164, (530) 792-5644, <http://www.ca.ncrs.usda.gov>

Private Sector:

American Farmland Trust, California Regional Office, 260 Russell Boulevard Suite D, Davis, CA 95616, (530) 753-1073, <http://www.farmland.org>

California Native Plant Society, 1722 J Street, Suite 17, Sacramento, CA 95814; (916) 447-2677, email: cncps@cncps.org, <http://www.cncps.org>

Sacramento Tree Foundation, <http://www.sactree.com>

Trust for Public Land, <http://www.tpl.org>

California Rangeland Trust, 1221 H Street, Sacramento, CA 95814-1910, (916) 444-2096, <http://www.rangelandtrust.org>

California Oak Foundation, 1212 Broadway, Suite 810, Oakland, CA 94612; (510) 763-0282, <http://www.californiaoaks.org>

California Oak Mortality Task Force, <http://www.sudden oak death.org>

Newsletters & Publications:

Oaks 'n Folks published by Univ. of California Cooperative Extension, contact: ihrmp@nature.berkeley.edu

Forest Stewardship Newsletter, contact: llitman@pacbell.net

Wildlife Among the Oaks: A Management Guide for Landowners, 1995, ANR Pub. 21537

Vineyards in an Oak Landscape, 1998, ANR Pub. 21577

How to Grow California Oaks, 1995, ANR Pub. 21540

Guidelines for Managing California's Hardwood Rangeland, 1996, ANR Pub. 3368

A Planner's Guide for Oak Woodlands, ANR Pub. 3369 (Available September 2001)

Landscape Conservation Planning: Preserving Ecosystems in Open Space Networks, 1993, ANR Pub. 3370

Oaks on Home Grounds, 1984, ANR Pub. 2783

Management of Small Pastures, 1990, ANR Pub. 2906

Protecting Trees when Building on Forested Land, 1983, ANR Pub. 21348

*Other publications of interest to rural landowners are available from Agriculture and Natural Resources, Univ. of California, 6701 San Pablo Ave., Oakland, CA 94608, (510) 642-2431 or (800) 994-8849, <http://anrcatalog.ucdavis.edu>

This is a publication of the University of California Integrated Hardwood Range Management Program. Additional copies may be obtained at 163 Mulford Hall, Berkeley, CA 94720, (510) 643-5429. email: ihrmp@nature.berkeley.edu, <http://danr.ucop.edu/ihrmp/>

COMMUNITY ACTIVITIES

Throughout California, landowners are working together to solve common problems in the hardwood range. Many regional problems can only be solved by landowners working together in innovative ways. Here are a few examples of landowner efforts:

Landowner associations. In many areas, particularly newer subdivisions, landowner associations are working on a variety of issues including fire safety, regional landscaping, and woodland protection. One excellent example of such an endeavor is the Portola Valley Ranch, a Hardesty Associates project. This planned unit development in the foothills of the Santa Cruz Mountains includes areas of shared open space that are managed and maintained by the Ranch Homeowners Association.

Open space easements and dedications of land. In many areas individual landowners, entire developments, and local land trusts are dedicating lands to open space

uses through easements and a variety of other legal tools. Landowners dedicating such lands often enjoy some tax relief as well. The Trust for Public Land and the American Farmland Trust (both headquartered in San Francisco), the Marin Agricultural Land Trust, and many small community land trusts are just a few of the organizations that operate such programs.

Community groups have developed throughout California to sponsor a variety of education, protection, and woodland enhancement activities. These groups pursue public awareness and educational programs, tree planting projects, registry programs for significant individual trees, and lobbying efforts with local jurisdictions for ordinances to protect local tree resources. An excellent example of one such program is the Sacramento Tree Foundation.

Written by Sharon G. Johnson

Designed by Nancy Austin