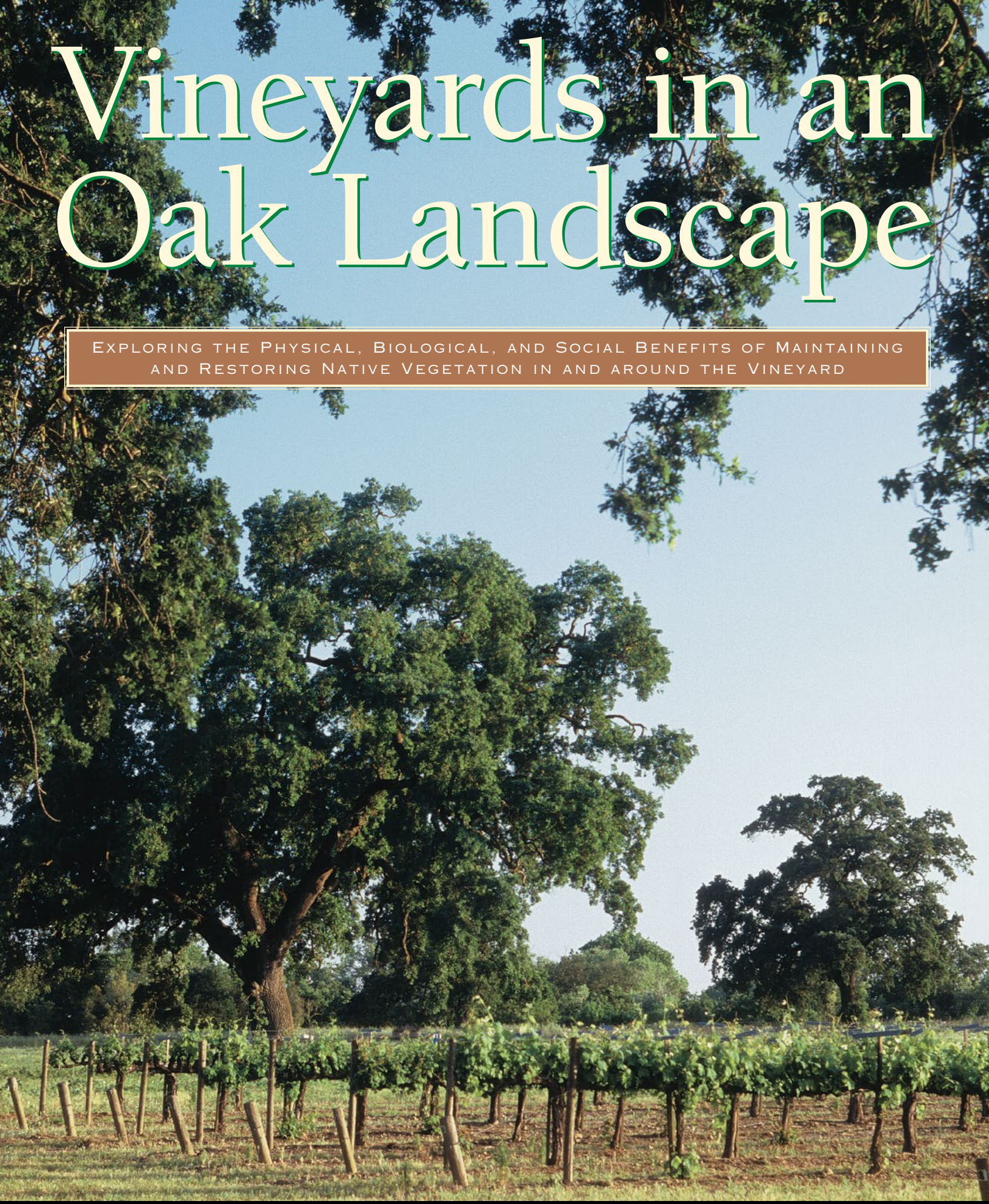
Vineyards in an Oak Landscape

Exploring the Physical, Biological, and Social Benefits of Maintaining and Restoring Native Vegetation in and around the Vineyard



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University of California
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Communication Services
2801 Second Street
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Telephone 1-800-994-8849
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Vineyards in an Oak Landscape

Exploring the Physical, Biological, and Social Benefits of Maintaining and Restoring Native Vegetation in and around the Vineyard

Adina M. Merenlender and Julia Crawford
Integrated Hardwood Range Management Program
University of California, Berkeley

Introduction

Grapevines have been cultivated in California since the late 1700s, when Spanish missionaries brought European vines with them to ensure a supply of quality wine. More recently, California wines have become extremely popular nationally and internationally, leading to increased demand for wine grapes. This trend has spurred the continued establishment of vineyards throughout California. Upland areas, historically considered marginal agricultural land, are increasingly targeted for vineyard development. In some areas, the conversion from woodlands and forest land to vineyard has been extensive. This publication provides background information on the biological interactions between vineyards and oak woodland habitats, the importance of biodiversity, diseases associated with native vegetation, and land management recommendations for minimizing environmental damage. This information should foster careful analysis of current and future vineyard development and management throughout California and help reduce negative impacts on our natural resources.

Recently, vineyard owners have been coming under increasing scrutiny from urban neighbors, environmentalists, and government agencies concerned about the effect of vineyards on natural resources. For example, riparian vegetation clearing, wetland conversion, endangered species, hillside erosion, native tree removal, and impeded wildlife migration corridors have become contentious issues facing vineyardists in California. Although landowners own the title of their land, they do not own the water, wildlife, or other resources outright and are responsible for managing these resources for the public trust. While many landowners consider themselves good stewards of their land, ensuring environmental quality can be ambiguous and difficult to balance with the demands of farming.

In several parts of California, much of the land that is currently being converted to vineyard is oak woodland. California's oak woodlands are part of our natural and cultural history. They provided food and shelter for native Californians and continue to provide people

Vineyard in an oak landscape, Napa County.

with goods and services such as firewood, forage for domestic livestock, and habitat for valuable game species. Oaks are esthetically pleasing and provide shade and cover. In fact, properties containing oaks or adjacent to oak woodlands often have higher market value than similar properties without oaks. Ecologically, oak woodlands are the most diverse ecosystems in California, providing critical habitat for approximately 2,000 plant, 160 bird, 80 mammal, 80 amphibian and reptile, and 5,000 insect species.

This habitat has undergone fragmentation due to suburban expansion, historic range improvement practices, and firewood harvesting. In fact, over 1,000,000 acres of California's oak woodlands have been converted since 1950. To complicate matters, several oak species are not regenerating adequately to ensure long-term species survival.

Vineyard development can have on-site, off-site, and cumulative impacts for a watershed. In Santa Barbara County, as many as 1,800 to 2,100 oaks were removed between 1996 and 1998 for new vineyards, more trees than all urban development and rural subdivisions were responsible for removing in the past 10 years. In Sonoma County, another rapidly expanding viticulture region, approximately 2,000 acres of woodlands have been replaced with vineyards since 1990. Like any agricultural product, demand for wine grapes is cyclic and varies with weather, consumer demand, and global markets. Given the economic cycles of grape production, exercising caution in planning vineyard developments is prudent in order to avoid long-term environmental costs for short-term economic gain. Given increasing development pressures, agricultural conversions, and inflated land values, Californians must develop innovative measures to retain the remaining oak woodlands and their ecological integrity, 80 percent of which are in the hands of private landowners.

Biodiversity in and around the Vineyard

Biodiversity has become a buzzword for environmentalists, public agencies, private citizens, and policy makers, but what is it and why is it essential to a healthy environment? Biodiversity is defined as the diversity of life in an environment at the genetic, species, and ecosystem levels of organization. In addition to the composition of life, biodiversity includes the ecological processes that link life forms together with soil, air, and water. Because these complex interactions among plants, animals, and abiotic factors allow ecosystems to function, most of the components of biodiversity are usually necessary for an ecosystem to be healthy. Changing

the composition of plants and animals in a community can affect ecosystem processes.

Biodiversity plays an important role in and around the vineyard. Proponents of sustainable agriculture maintain that lack of biodiversity in conventional farming systems promotes insect pests and disease and can necessitate the use of disruptive insecticides, fungicides, herbicides, and fertilizers. These additions cost time and money and can have long-term effects on soil, water, and other natural resources. There are many ways in which grape growers can maintain or even increase biodiversity on their property and work toward an ecologically healthy vineyard habitat.

Many growers have adopted sustainable agricultural practices within the vineyard. For example, native California grasses are being used by some as cover crops to increase biodiversity and reduce the problem of invasive weedy species that can spread to natural areas. California native grasses currently used in vineyards include California barley (*Hordeum brachyantherum* ssp. *californicum*); California brome (*Bromus carinatus*); California melic (*Melica californica*); creeping red fescue (*Festuca rubra*); Idaho fescue (*Festuca idahoensis*); meadow barley (*Hordeum brachyantherum ssp. brachyantherum*); nodding needlegrass (*Nassella cernua*); pine bluegrass (*Poa secunda* ssp. *secunda*); and purple needlegrass (*Nassella pulchra*).

In addition to native cover crops, some grape growers are planting hedgerows with a mix of California native flowering shrubs between several rows of grapes to increase biodiversity and attract beneficial insects to the vineyard.

Many grape growers and wineries own land that is partially developed as vineyard and may be surrounded by oak woodland, savanna, or riparian communities that provide critical habitat for wildlife. This valuable habitat and the wildlife it supports are key components of biological diversity. Deer, rabbits, gophers, ground squirrels, starlings, and blackbirds can be serious pests in a vineyard. However, many species such as predatory birds (red-tailed hawks, red-shouldered hawks, American kestrels, great horned owls, and barn owls) that are commonly found in oak woodlands prey on resident rodent populations and can benefit grape production. Bats and bobcats living in neighboring woodlands can also help reduce pest populations with little effort from growers. Vineyardists can do their part by caring for the oak habitat on their land, protecting individual trees, and preserving large continuous tracts of woodland.

Oak woodlands, the most ecologically diverse ecosystems in California, provide much-needed habitat for a wide variety of plants and animals.

Vines planted beyond the canopy of a valley oak (*Quercus lobata*).

Protecting Oak Trees

There are several practices that can help ensure the longevity of oak trees within or adjacent to vineyards. In cultivated landscapes, irrigation is commonly associated with the decline of oak trees. Oak trees are adapted to California's dry climate, and supplemental watering, especially in the warm summer months, can cause rapid decline. To conserve water and protect oaks, use sprinkler guards so that irrigation or frost protection water does not reach the oaks. Planting vines beyond the edge of the tree's canopy will provide a buffer zone, protecting the tree's root system against soil compaction and preventing the grapevines from being shaded by the oaks. When conducting mechanical practices such as disking, spraying, or seeding for cover crops, avoid the area underneath the tree canopy by lifting the disk or turning off the sprayer. Avoid fertilizing oak trees with nitrogen. This stimulates foliage growth, which can lead to grapevine shading and tree decline.

Ensuring an adequate supply of oak seedlings to replace mature trees as they die is an essential component of sustaining oak woodlands. Oak seedlings need protection from herbivores and relief from weed competition. Ground squirrels, pocket gophers, and grasshoppers can damage seedlings, diminishing survival rates. Grow tubes, perforated PVC, leftover wire, or piles of brush can serve as protection for seedlings. Controlling weeds around new oak seedlings reduces competition for water and nutrients from annual grasses and weeds and can greatly increase the success rate of new seedlings.

Vine Disease and the Role of Native Vegetation

PIERCE'S DISEASE

Cultivated grapes often suffer from plant pathogens that occur naturally in native vegetation. Two diseases that are sometimes associated with valley oak riparian areas or foothill oak woodlands are Pierce's disease and oak root fungus. Pierce's disease is responsible for millions of dollars in damage to California's vineyards. Found in California in the late 1800s, it is widespread throughout the southern Unites States and is generally restricted to areas with mild winters. It is not found north of California, in more inland areas, and at higher elevations such as the Sierra foothills. The disease is caused by the bacterium *Xylella fastidiosa*, which is transmitted by small insects belonging to the sharpshooter (Cicadellidae)

and spittlebug (Cercopidae) families. The most important vectors are the blue-green sharpshooter (*Graphocephala atropuctata*), the green sharpshooter (*Draeculacephala minerva*), and the red-headed sharpshooter (*Carneocephala fulgida*), which live in riparian woodlands and irrigated grasslands. As the bacteria multiply, they block the vine's water conducting system, reducing water and nutrient transport. The disease is virulent and aggressive and can cause rapid decline and death in severely infected grape plants. There is no known cure or effective control for the disease, making it particularly devastating for growers.

Recent research has shown that several plants found in the understory of riparian woodlands are associated with the spread of Pierce's disease, including wild grape (*Vitis californica*), Himalayan blackberry (*Rubus discolor*), French broom (*Genista monspessulana*), and periwinkle (*Vinca major*). Unfortunately, fear over the spread of the disease and misinformation about the disease's etiology have led to indiscriminate clearing of riparian woodlands in areas where the disease is present, such as California's North Coast. Because riparian vegetation plays a critical role in soil stabilization and maintaining water quality and wildlife habitat, management of riparian vegetation adjacent to vineyards should consider potential impacts and benefits to stream health, as well as being consistent with local, state, and federal regulations.

If growers want to completely remove detrimental understory such as blackberry and periwinkle, manual removal should be completed during the dry season and appropriate native vegetation should be planted to help stabilize stream banks. Mature riparian vegetation that will most likely not propagate sharpshooters include oaks, California bay laurel (*Umbellaria californica*), red alder (*Alnus rubra*), arroyo willow (*Salix lasiolepis*), red willow (*S. laevigata*), and sandbar willow (*S. sessilifolia*). Vegetation removal or other physical manipulation activities along stream courses should not be done without first consulting the California Department of Fish and Game (CDFG) for guidance. Also, because these riparian woodlands provide optimum habitat for valley oaks that now occupy only 10 percent of their former range, valley oak protection should be a priority. Because most vine loss occurs within 200 to 300 feet (61 to 91 m) from the vector's habitat, retaining a buffer zone greater than 300 feet (91 m) between riparian habitat and grape vines is advisable. For more information on Pierce's disease, see *Grape Pest Management* (UC DANR Publication 3343) and *Pierce's Disease in the North Coast* (UC Cooperative Extension Sonoma County, 1997).

Blue-green sharpshooter (*Graphocephala atropuctata*), one of the most important vectors of Pierce's disease.

Foliar symptoms of Pierce's disease.

OAK ROOT FUNGUS

Armillaria root rot (also known as oak root fungus) is another example of how native vegetation management can directly affect the health of a vineyard. This disease is a long-term problem for grapevines that has been recorded in California since the 1880s. The causal fungus (*Armillaria* sp.) attacks the roots of a plant, travels up the inside of the bark, and girdles the plant, resulting in decay of woody tissues. Symptoms of the disease in grapevines include poor shoot growth, premature yellowing and dropping of leaves, dieback, and eventual death of the vine. The disease occurs in discrete infection centers that expand slowly. The slow spread of the pathogen occurs mostly by growth of rootlike branches that extend beyond the roots of the host plant and contact and infect other roots. Once established at a site, the disease can persist for up to 100 years in woody debris such as decomposing roots and stumps in the soil.

Armillaria root rot is potentially a major constraint to hillside vineyard development. Although most commonly associated with native oak stands, *Armillaria* fungus species are natural components of most, if not all, forest and woodland ecosystems in California and throughout the northern hemisphere. The fungus is generally found in small lesions on the root system and root collar and has threadlike branches clinging to the outside of the root. Direct examination of

Foliar symptoms of oak root fungus.

infected trees is the only way to determine the presence of Armillaria. In 1996, UC plant pathologists checked 240 trees in an apparently healthy oak-madrone woodland in Sonoma County that was destined to be cleared and converted to vineyard. At a soil depth of 1 foot (0.3 m), *Armillaria* was found on the root systems or crowns of at least 50 percent of the trees. Native woodland trees have coevolved with Armillaria and the fungus rarely causes major damage in healthy woodlands. However, when native trees are cut, the dying and decomposing root systems provide an ideal reservoir for the fungus, which then colonizes the decaying wood and becomes a virulent pathogen. Under these conditions, *Armillaria* is more likely to infect newly planted vines, especially when irrigation is used.

Developing resistant grape rootstock offers the best possible opportunity for long-term control of this disease. Trials are also being conducted with chemical and biological control of the disease. However, until research finds a more effective way of controlling Armillaria root rot in vineyards, proactive management of hardwood trees adjacent to new vineyards is the best option. If there are oaks or other trees that may be infected with the fungus on the edge of a vineyard, consider leaving these trees uncut. Research indicates that living mature trees can serve as a host to the fungus without substantially increasing the spread or virulence of the disease. Whenever possible, leave buffer zones of approximately 200 feet (61 m) between oaks and grapevines. This distance can be included in the equipment turnaround space at the end of rows.

Rhizomorphs of *Armillaria* sp., the causal organism of oak root fungus.

If a vineyard is planned that requires the removal of trees, have the trees inspected and tested for the presence of Armillaria. If the fungus is well established in the area, reconsider the choice of planting sites. If it is necessary to remove a tree, eliminate as much of the root system as possible. Observations in pear orchards have led researchers to believe that normal orchard irrigation practices increase the spread and vigor of the fungus. Although preplant soil fumigation is performed in some vineyard developments, this practice is not usually effective for eradicating Armillaria. In fact, this expensive procedure can present a human health hazard and may kill the fungus only in the top layers of soil. If the dis-

ease remains, the young vines will become infected once their root systems grow down into the infected soil layers.

Vineyard Development: Best Management Practices

The California wine industry traditionally has had a positive public image. California's well-informed consumers are highly aware of water quality, wildlife, and other environmental concerns. Several vineyard developments that had extensive tree removal or severe erosion have brought attention to the potential impact of grape growing on natural resources. This has lead to extensive press coverage of the issue and compelled several county governments, including Napa, Sonoma, and Santa Barbara, to seek a solution to the problem. With today's consumers becoming increasingly sensitive to environmental issues, the positive public image generated by managing natural resources in a sustainable way is beneficial. Also, property with substantial tree cover and healthy streams is generally more valuable than cleared property with soil and stream bank erosion problems. The following issues should be considered when minimizing the environmental cost of vineyard development and management.

NATIVE TREE REMOVAL AND POSSIBILITIES FOR MITIGATION

While most agricultural conversions do not require permits and are therefore not subject to various environmental policies such as the California Environmental Quality Act (CEQA), vineyard development can result in extensive tree removal, which impacts oak woodland habitat quality. In addition to the on-site impact of tree removal, off-site impacts can result when adjacent wildlife habitats are reduced in size, wildlife corridors are severed, and recreational uses and views are compromised or eliminated. Cumulative environmental effects result from decreases in biological diversity by eliminating oak habitat, reducing the population of rarer oak species, and increasing habitat fragmentation.

It is highly desirable to mitigate these impacts as an important step toward preserving California's oak woodlands and addressing public concern over extensive habitat loss. Measures range from on-site single-tree protection to off-site habitat enhancement or protection. Single-tree approaches or those that seek to protect small areas may mitigate aesthetic or cultural resource impacts but usually do little to reduce impacts to wildlife habitat or open space values. Consider, where possible, a more cost-effective use of funds for habitat conservation. On-site mitigation can often be accomplished by tree replacement. Several counties have tree replacement or removal requirements that range from 2:1 to 16:1 for valley oaks greater than 20 inches (51 cm) in diameter at breast height. Tree replacement goals depend on the size and quality of the replacement stock, techniques used, and follow-up care and monitoring. Growers should focus on rarer oak species such as valley oaks when trying to preserve or plant trees.

Off-site measures may be necessary for large-scale woodland removal (greater than 30 acres [12 ha]) or where space for on-site mitigation is limited. However, because off-site mitigation does not prevent the loss of

A vineyard on the edge of an oak woodland in Sonoma County.

important biological functions that may be limited in and around the project site, off-site mitigation should be carefully considered. The following criteria may help identify hardwood areas that may serve as off-site mitigation: the presence of specific oak species; areas with high levels of natural regeneration; threatened species habitat; wildlife migration corridors; habitat diversity; and riparian vegetation. Specified mitigation areas should be protected as natural habitat in perpetuity. Establishing a protective easement through county government open space districts can accomplish this, where available, or through nongovernmental organizations supporting land trusts.

RIPARIAN AREA AND WETLAND CONSERVATION

In addition to facilitating wildlife migration, riparian vegetation has several important ecosystem functions, including stabilizing soil, filtering sediment and nutrients from agricultural runoff, reducing risk of flood damage, and providing nutrients to the stream ecosystem. Riparian vegetation contributes to bank stability through root systems that anchor soil and by slowing the velocity of high flows. The loss of riparian vegetation is frequently implicated in increased rates of stream bank erosion. Riparian vegetation also provides important nutrients to the stream from leaf litter and branches. Larger branches and trunks provide in-stream structure and cover and play a major role in channel-forming processes such as pool formation and gravel bar stabilization. Riparian vegetation also provides shade, reducing solar input to the stream and maintaining lower water temperatures that are necessary for survival of cold-water fish such as steelhead and coho salmon.

Activities that degrade or fragment riparian vegetation include direct clearing of vegetation, inundation behind dams, and alterations in hydrological regimes through managed flows. In the western United States, identification of the links between riparian degradation and the decline of anadromous fisheries has prompted much interest in the protection and restoration of riparian corridors. Stressors such as planting agricultural crops too close to the stream corridor can act as ecological constraints to system recovery; removal of such stressors often allows the system to "repair" itself. However, it is often necessary to plant native vegetation and perform in-stream stabilization if the stream course is entirely denuded.

Fragmented oak woodland in Sonoma County open to vineyard development.

Various cost-share assistance programs are available through state and federal agencies to assist landowners with riparian restoration projects.

Another important threatened wetland habitat often found in California's oak woodland habitats are vernal pools. Vernal pools are seasonal bodies of water that form in shallow depressions following winter rains. Because of an underlying hardpan layer, water may persist for several months, providing a wetland oasis for many uniquely adapted species of plants and animals. Waterfowl, frogs, salamanders, dragonflies, and numerous aquatic insects use the pools for feeding, breeding, and juvenile development. Over tens of thousands of years, a number of highly specialized plants, and macroinvertebrates such as fairy shrimp, have evolved to exploit the flood-drought cycles associated with vernal pools. Because many environmental and biological factors influence pool ecology, species abundance and composition in one pool is quite different from that of a neighboring pool. Long thought of as mud puddles or mosquito breeding sites, or simply ignored altogether, vernal pools are now recognized as unique natural resources worthy of preservation.

Today, many intact pools are located throughout the oak woodlands of the Coast Ranges and the foothills of the Sierra Nevada in sites traditionally grazed by livestock that may currently be under consideration for vineyard development. Vernal pools are wetlands and may therefore be considered under CEQA and the federal Clean Water Act. Landowners should contact the U.S. Natural Resources Conservation Service (NRCS) before filling, contouring, or manipulating any vernal pools to obtain advice on wetland designation and management.

Because vernal pools often harbor rare, threatened, or endangered plants and animals, the CDFG is also concerned with their preservation and enforces their protection. Newly planted vineyards should generally be set back from wetlands and riparian areas by a minimum of 50 feet (15.2 m) for lower-sloping areas to 150 feet (45.7 m) for steep hillside developments. Mature native vegetation should be maintained or established along streams to provide physical stabilization and biological integrity. In particular, the topography of land surrounding pools and streams should not be altered as this will change the natural hydrologic flow and damage these fragile ecosystems.

EROSION CONTROL

The 1987 reauthorization of the federal Clean Water Act increased emphasis on controlling nonpoint source pollution, especially from cropland and rangeland runoff. Sediment is a large contributor to nonpoint source pollution. It raises water temperature, increases streambed incisions, and precludes suitable spawning grounds for anadromous fishes. Vegetation removal, grading, exposing bare soil, and road building all contribute to soil erosion and sedimentation.

To reduce sedimentation, the removal of native vegetation should be minimized in areas surrounding vineyards. Vegetation is the best protection for bare soil surfaces because it anchors the soil, absorbs water by pulling it deeper into the soil profile, and slows the flow of water over the soil surface. Using California native species as a cover crop helps control erosion while enhancing biodiversity in the vineyard.

Grading, recontouring, and resurfacing for vineyard development should focus on facilitating proper drainage and avoiding concentrated water flow. If flow must be focused, protect the outflow area with an energy dissipater. Ditches and ditch relief culverts should never be discharged directly into a watercourse but should flow through an adequate vegetative filter strip. During construction, filter strips of bales of straw or other absorbent materials should be used. In addition to erosion control measures during development, proper road development and maintenance is essential for long-term soil erosion control.

Vehicle use on unpaved roads during and shortly after rainfall increases fine sediment transport and may cause ruts and gullies that must be removed later through grading. When possible, road use should be restricted for 1 to 2 days after heavy rainfall, allowing some evaporation and reducing the potential for movement of soil fines that are easily mobilized along wet roads. The two erosion control techniques most appropriate for unpaved roads are rolling dips and water bars. Rolling dips are more appropriate for all-season roads, while roads with water bars should not be used during the rainy season.

Additional information on erosion control and soil conservation is available through local NRCS offices. The NRCS can also help with soil erosion control plans for all vineyard development and management activities.

WILDLIFE IN AND AROUND VINEYARDS

With some planning, landowners can greatly increase the chances for the survival of native plants and animals on their property. The structure of a woodland parcel affects its value for wildlife habitat. Some important structural components include dead and downed logs and other woody debris, brush piles for cover, standing dead wood (snags), and rock formations and outcroppings. For example, 60 bird species rely on standing dead branches and trees for nesting and more than 40 mammal species use brush piles and other downed woody material in California's oak woodlands. Removing large snags adversely affects arboreal salamanders, acorn woodpeckers and other birds, and bats. Removing small snags (less than 6 inches [15 cm] in diameter) is less likely to affect these species but will reduce the source of dead wood on the ground. Wood on the ground in the form of logs and branches is consumed by a number of invertebrates and fungi and is one of the major sources of nutrients and energy under oak canopies. Many wildlife species prey on wood-consuming invertebrates, including

salamanders, rodents, and birds. Brush piles provide habitat for birds that nest on the ground and low shrubs, such as the California quail, whitecrowned sparrow, and goldencrowned sparrow, and removal of brush piles reduces the habitat value for these and other wildlife species. Therefore, mature vegetation and dead woody debris should be maintained in and around the vineyard to provide essential habitat features for wildlife. Rock outcrops and cliffs are used by birds, bats, and reptiles. Trails and roads built too close to rock outcrops can lessen their habitat value.

The choices landowners make about the size and placement of their vineyards can reduce the impact on the surrounding habitat. Habitat fragmentation is a major threat to the viability of many wildlife populations, and wildlife isolated in small patches of habitat is often in greater danger of localized extinction. The greatest risk is when small (less than 25-acre [10-ha]) regional woodlands are isolated from larger expanses of woodland. Chance events such as wildfires and epidemics can seriously impact these small woodland patches to a greater degree than larger blocks. Large mammals and raptors are especially sensitive to habitat fragmentation because they require large tracts of woodland in which to range. Extensive clearing of oak woodland should be avoided in the middle of contiguous woodland habitat, especially if the cleared area will lead to isolated small habitat islands. In addition to habitat fragmentation, fencing can also prevent wildlife migration. Fences should be used only in areas where wildlife can damage vines. The fences should be restricted to the planted area only and eliminated where not absolutely necessary.

Although the survival of wildlife in fragmented habitats ultimately depends on animals' ability to move between fragments in order to maintain access to necessary resources, many wildlife species are hesitant to move through cleared areas. In an effort to conserve wildlife in fragmented landscapes, managers and conservation biologists have proposed the maintenance of habitat corridors, strips of relatively intact habitat designed to help animals move between two or more otherwise disjunct habitats. Riparian areas are a primary source of wildlife corridors. While riparian corridors protect riparian systems and can be important habitat for some species, some wildlife may prefer nonriparian or upland corridors. Factors such as the dimension, location, and quality of habitat in corridors can influence wildlife use. Narrow corridors (less than 100 feet [30.5 m] wide) are generally less effective than wider corridors. If the available distribution of hardwoods is already in the form of narrow corridors, the existing linear configuration should be maintained.

Acorn woodpecker (*Melenerpes formicvorus*)

ENDANGERED SPECIES

The U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service are the federal agencies charged with the responsibility to administer the Endangered Species Act of 1973. In general, the purpose of this act is to conserve threatened and endangered species and their habitats. Endangered species are those species that are in danger of extinction throughout all or a significant portion of their range. Species may be classified as "threatened," a less severe classification than "endangered," when their habitat or range is threatened by natural or manmade factors that affect its continued existence.

More than 950 species of plants and animals native to the United States, and more than 560 species living in other parts of the world, have been placed on the U.S. List of Endangered and Threatened Wildlife and Plants and thus receive protection under the Act. Nearly 4,000 species are listed as candidates for protection. An estimated 5,000 more species are in need of protection but have not been legally recognized. California also provides protection for endangered and threatened species under the California Endangered Species Act, which currently protects 25 mammals, 30 birds, 21 reptiles and amphibians, and 23 fish along with numerous plant species.

Lists of candidate, threatened, and endangered species and their locations are available through the CDFG's California Natural Heritage Division and USFWS. In addition, the Natural Diversity Data Base, maintained by the Natural Heritage Division, has its own lists of endangered and threatened plants. This listing provides some protection for the plants under the California Endangered Species Act and should be fully considered during preparation of environmental documents relating to CEQA. The California Native Plant Society (CNPS) also has a listing of rare and threatened native plants that can be obtained from local CNPS chapters.

Many listed species occur partially or entirely on private lands, making protection on private land essential for conserving and recovering listed species. If threatened or endangered species are found in areas where vineyard development is planned, an "incidental take" permit from the USFWS may be required. The USFWS, at the time a species is listed, is required to publish notice of activities that would not be considered a "take" of the species being listed. This reduces landowner uncertainty about what is and is not a legal taking and can relieve landowners from having an incidental take permit when an activity is included in such a notice. Also, the National Marine Fisheries Service should be notified of agricultural activities such as increased sediment transport to riparian areas that may affect stream habitat quality and impact fish survival.

Economic Incentives

There are many reasons to conserve or restore oak woodlands and riparian areas. Frequently, the decision to do so involves economic analysis. Although landowners rarely think of natural vegetation as economically rewarding, through government programs or conservation easements, they can often receive financial assistance. This help can come in many forms: cash for special projects, reimbursements for restoration, tax credits, or conservation easements. Conservation easements typically allow the landowner to continue to farm part of the land while retaining important conservation areas on other parcels in an undeveloped state. Conservation easements, while not for everyone, are ideal to ensure that land remains in an open state without unduly restricting landowners' rights. In fact, most land trusts will design easements to meet individual landowners' needs. Local NRCS offices have information on land trusts and open space districts in specific areas. The NRCS and University of California Cooperative Extension also have information on a variety of economic incentive programs to encourage private landowners to conserve natural resources.

Lessons from a Grape Grower in Carneros District

Lee Hudson is a grape grower in the Carneros Valley, Napa County. Since 1981, Mr. Hudson has developed 150 acres [61 ha] of wine grapes. Because of the configuration of his land, these vineyards have been developed in small 10-acre (4-ha) blocks surrounded by streams and creeks that are part of the Huichica Creek watershed. For Mr. Hudson, water quality issues and regulations greatly affect his land management decisions. An active participant in the Huichica Creek Land Stewardship Program, Mr. Hudson has always valued the environmental health of his land, as well as its production value, but his philosophy has evolved over time. "When I first started farming, I planted right up to the creek," says Hudson. "Now those parcels are always causing me problems. I am always having to fight with the creek, putting in riprap to stabilize banks, and so forth. And the vines planted close to the creek are either too vigorous or not vigorous enough, leaving me with green fruit that the wine maker doesn't want!"

> We have a responsibility to make sure that the water that runs off our vineyard is as clear and clean as possible.

In 1994, Napa County implemented a hillside development ordinance that addressed local concerns about the effects of soil erosion and water quality. Since the hillside development ordinance was passed, Hudson has planted his vineyards farther from the edge of the creeks, and these vineyards have caused him far fewer headaches. "I don't have to fight with the creek anymore," he says.

For Lee Hudson, the hillside development ordinance has had some unexpected benefits. He feels that the regulation has helped him become a better farmer. He pays more attention to things that have always been important but were sometimes overlooked because they did not have immediate impacts. For example, he is more concerned now about the quality of water running off his property and believes that the natural riparian vegetation corridors have stabilized the stream banks, increased wildlife, and improved water quality. Now, when he plants a vineyard he leaves setbacks that are 20 percent more than required by the hillside ordinance. On his property, this means 10 percent less producing vineyard overall. Yet he is philosophical about his decision to give up a little land to benefit water quality and biodiversity. "Farming is a lot of work! If it's 10 percent less farming, that means 10 percent less work for me," Hudson says with a laugh. "Besides, I like seeing the increased amount of wildlife and I like to hunt."

Acknowledging that his philosophy is costing him money, Mr. Hudson coins it as an opportunity cost rather than cash out of pocket. He sees the benefits from allowing natural riparian vegetation to serve as wildlife habitat, bank stabilizers, and soil filters. It is a very effective and easy way to deal with a critical issue. "We have a responsibility to ourselves and our community to make sure that the water that runs off our vineyard is as clear and clean as possible, and as free of any pollutants as possible," he says. While he doesn't mention regulatory responsibility, Mr. Hudson knows that his clearer water means healthier aquatic life and compliance with the federal Clean Water Act. Since Huichica Creek is home to a federally listed endangered species, the California freshwater shrimp, clean water is especially important.

Mr. Hudson is now thinking about how he can help restore his riparian corridors. He has noticed that some trees are not regenerating and talks about planting more. He also wants to encourage a native shrub component that will in turn encourage wildlife such as quail. Lee Hudson has set an admirable example of how to find cost-effective, innovative ways to grow quality wine grapes while ensuring natural biodiversity, soil retention, and clean water.

Vineyard Development Checklist

The following checklist is designed to help vineyard owners consider the full range of natural resource issues during the vineyard planning process. While some of these items may seem obvious to experienced farmers, each new site deserves thorough consideration before vegetation removal begins.

☐ **Does the site have soils suitable for growing grapes?**
Check with the local NRCS office to obtain a local soils map or have the soils tested by a qualified soil scientist. Highly erodible, shallow, and serpentine soils, for example, are poorly suited for growing grapes.

☐ **Does the site contain slopes that are over 20 percent?**
Steep hillsides are prone to erosion even when proper precautions are taken. In addition, steeper slopes require terracing, which is costly and labor-intensive to install, maintain, and farm and can cause safety concerns for equipment operators.

☐ **Is there a sufficient water supply?**
New vineyards need water to establish young vines. Many sites also require water for early-spring and late-fall frost protection and summer irrigation.

☐ **Does the parcel contain oak woodland?**
If so, minimize hardwood removal and check for oak root fungus and other diseases that may be present before clearing any native vegetation. The presence of disease may affect the configuration of your vineyard design.

☐ **Have an experienced vineyard manager or local agency representative review the vineyard development plan for potential problems.**

Ready to plant? Here are a few more things to consider before moving ahead.

☐ **Is the project realistic in scope?**
Develop the site in phases to ensure that planting is finished or a protective cover crop and erosion control practices are in place before the rainy season begins. This will reduce the potential for unnecessary soil erosion.

☐ **Does the site contain large heritage oaks (trees over 100 years old)?**
If so, consider leaving them and planting around the drip line.

☐ **Are the riparian communities and wetlands protected by appropriate setbacks?**
Many counties and the CDFG have recommended stream and wetland setbacks. Check with the county planning department for local regulations. Leaving riparian vegetation can stabilize stream banks, provide a filter for soil erosion, reduce costs for future stream bank stabilization, and protect portions of the vineyard from being lost to stream bank failure.

☐ **Is there an erosion control plan?**
Will the position and orientation of the rows minimize native vegetation removal and soil erosion? When a project calls for removing native vegetation or extensive grading, many counties require a grading permit that includes an erosion control plan. Regardless of whether an official plan is required, this exercise is helpful to ensure appropriate short-term and long-term erosion control measures.

☐ **Will additional roads be installed?**
If so, check with the local NRCS office for suggestions on proper grading and drainage techniques. Roads can be a major source of sediment in local creeks and streams. Sediments can cover and cement gravel stream beds, inhibiting fish spawning. In addition, fine sediment can increase the water temperature, reducing the oxygen-holding capacity of water and making adequate oxygen exchange difficult for aquatic life.

☐ **Has a qualified person been chosen to install the new vineyard at the best time of year?**
Vineyard development is an expensive proposition. An experienced, qualified person can minimize mistakes during development and throughout the life of the vineyard. Before hiring someone, check their references and view their work or call the local NRCS office or Resource Conservation District for a list of management companies and consultants with vineyard development experience.

☐ **Are fences going to be erected?**
If so, minimize the fenced area to reduce the overall effect on wildlife migration.

Where Do We Go from Here?

Issues surrounding the management of native vegetation, including oak woodland habitat, have become increasingly important for all landowners. The interface between urban development, agriculture, and native vegetation is complex and constantly changing. Because research on the interface between agriculture and oak woodlands has only recently begun in earnest, the interactions between native vegetation, wildlife, and vineyards in the landscape are not well understood. Vineyardists can help by looking for ways to incorporate components of natural habitats into their management plans, reducing the impact of habitat loss and fragmentation while protecting their vineyards from pests and diseases. After considering the information in this publication, landowners may want to take an inventory of the natural resources on their property. Assuming that the entire property will not be developed, what natural resource conservation issues will become priorities? Are there riparian and wetland resources that can be kept out of agricultural production or restored? Does the property provide habitat for endangered species? The optimal scenario would consist of economically healthy vineyard that is designed and managed in a way that maximizes the diversity of healthy ecosystems.

For Further Information

ORGANIZATIONS

California Department of Fish and Game (CDFG)
1416 9th St.
Sacramento, CA 95814
Phone: (916) 653-7664
Website: http://www.dfg.ca.gov/

California Department of Forestry (CDF)
1416 9th St.
Sacramento, CA 95814
Phone: (916) 653-5121
Website: http://www.fire.ca.gov/

California Native Plant Society (CNPS)
1722 J St., Suite 17
Sacramento, CA 95814
Phone: (916) 447-2677
FAX: (916) 447-2727
Website: http://www.calpoly.edu/-cnps_ main.html/

California Oak Foundation
1212 Broadway, Suite 810
Oakland, CA 94612
Phone: (510) 763-0282

UC Integrated Hardwood Range Management Program (IHRMP)
145 Mulford Hall
University of California
Berkeley, CA 94720-3114
Phone: (510) 643-5429
Website: http://danr.ucop.edu/ihrmp

UC Statewide Integrated Pest Management (IPM) Program
University of California
Davis, CA 95616-8621
Phone: (530) 752-8350
Website: http://www.ipm.ucdavis.edu/

UC Sustainable Agriculture Research and Education Program (SAREP)
University of California
Davis, CA 95616-8716
Phone: (530) 752-7556
Website: http://www.sarep.ucdavis.edu

RESOURCES

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Wildlife among the Oaks. Oakland: University of California Division of Agriculture and Natural Resources, Publication 21537, 1996.