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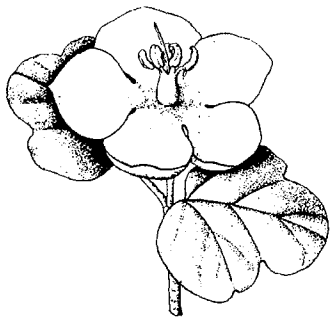
FREMONTIA

A Journal of the California Native Plant Society



WILDLIFE AND OAK-WOODLAND INTERDEPENDENCY

by William M. Block, Michael L. Morrison, and Jared Verner

YEAR OF THE OAK

FREMONTIA

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Phyllis M. Faber, Editor
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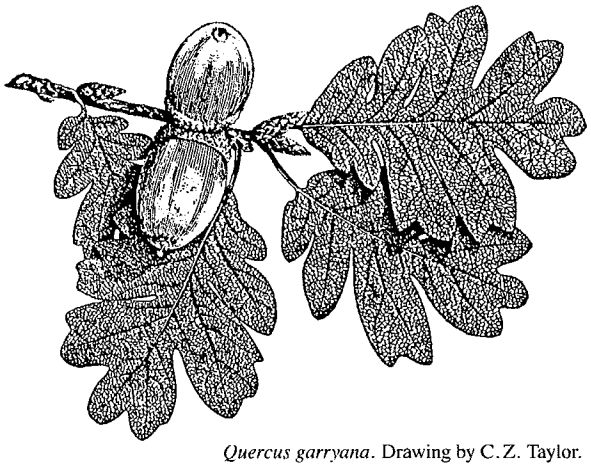
California Native Plant Society

Dedicated to the Preservation of the California Native Flora

The California Native Plant Society is an organization of laymen and professionals united by an interest in the plants of California. It is open to all. Its principal aims are to preserve the native flora and to add to the knowledge of members and the public at large. It seeks to accomplish the former goal in a number of ways: by monitoring rare and endangered plants throughout the State; by acting to save endangered areas through publicity, persuasion, and, on occasion, legal action; by providing expert testimony to government bodies; and by supporting financially and otherwise the establishment of native plant preserves. Much of this work is done through CNPS Chapters throughout the State. The Society's educational work includes: publication of a quarterly journal, *Fremontia,* and a quarterly *Bulletin* which gives news and announcements of Society events and conservation issues. Chapters hold meetings, field trips, and plant and poster sales. Non-members are welcome to attend.

The work of the Society is done by volunteers. Money is provided by the dues of members and by funds raised by chapter plant and poster sales. Additional donations, bequests, and memorial gifts from friends of the Society can assist greatly in carrying forward the work of the Society. Dues and donations are tax-deductible.



Quercus garryana. Drawing by C.Z. Taylor.

THE COVER: California blue oak (*Quercus douglasii*) growing in the Coast Range, California. Photograph by David Cavagnaro.

EDITORIAL

1990 is the official "Year of the Oak" as designated by the California Legislature. To honor the spirit of this designation, the July issue of *Fremontia* focuses on the California native oak with subject matter ranging from the distribution and ecology of different species of oaks, to the wildlife that depends on them, and finally to policies and practices that affect the future of the oak in California.

This special issue on native oaks was undertaken at the urging of the newly formed California Oak Foundation, the driving force behind naming 1990 as the Year of the Oak and a nonprofit with a single agenda of preserving our California oak. Pam Muick, an ecologist now completing her doctoral dissertation in the Department of Forestry and Resource Management at the University of California at Berkeley, was instrumental in identifying oak researchers who might contribute to this issue. She has made helpful suggestions in reviewing many of their manuscripts and has contributed her own writing. Dave Cavagnaro has generously contributed many of his extraordinarily beautiful photographs for use in the oak issue for which we thank him. The collection of articles in this issue represents a summarization of much of what is known about oaks in California today. Many of the authors are extraordinarily busy people; their willingness to make a contribution to *Fremontia* and their cooperative spirit has been gratifying. Following our customary procedure for *Fremontia,* all articles are reviewed by one or more reviewers; their efforts, particularly those of Dr. Robert Ornduff of the Department of Integrative Biology at University of California at Berkeley, make *Fremontia* a more worthy journal but the task—especially with more than four times the material of a single issue—a large one. The production of this oversized oak issue has put a considerable burden on the people involved: Barbara Leitner in copy-proofing; Susan Ross, typing and coding; Neal Elkin, typesetting; Beth Hansen, design; and Susan Birnbaum, paste-up. Their spirit and extra effort is much appreciated. Laurence Hyman regularly provides helpful advice and guidance as art director and James Barry & Co. high quality printing for Fremontia.

The genus *Quercus* is both a familiar and a beloved feature of the landscape in many parts of California; yet, it is not faring well. Native oaks have been cleared to make room for more grazing or for agriculture; they have been extensively cut for firewood; they have been cleared for urban development; and they have been preserved and then killed by overwatering in urban areas. We have not valued the magnificent native oaks of California until recently and now we realize that something is wrong. Where oaks remain in the landscape, there are almost no young oaks and the reasons are not clear or at least simple. Many of the contributors to this issue are working hard to unravel the complexities of oak ecology in the changing environment of present-day California. We wish them well. We hope planners and government officials working with private landowners will devise ways to preserve oak habitat. We hope the public will recognize the value of the oak and the wildlife that depends on it and provide support for oak preservation and for oak restoration projects. It is hard to imagine the California of tomorrow without the magnificence of today's oaks.

Phyllis Faber

WILDLIFE AND OAK-WOODLAND INTERDEPENDENCY

by William M. Block, Michael L. Morrison, and Jared Verner

The activities of wildlife underlie the very existence of oak woodlands. Presently, more than 300 vertebrate species are known to use oak-dominated woodlands in California for reproduction; additional species use oak woodlands as wintering grounds or during migration.

Both deer and rabbits browse oaks, sometimes altering their shapes significantly. Photographs by David Cavagnaro.

Even though these animals may not breed in oak woodlands, they require food and cover to survive the winter and also to acquire adequate energy reserves for migration to their breeding grounds. Thus, the use of oak woodlands by these non-breeding species is as important for their survival and reproduction as it is for those that breed in oak woodlands. Oak woodlands, therefore, are critical for the conservation of both breeding and non-breeding species.

Presently, many species of special concern are found in California oak woodlands, some of which are listed by federal or state agencies as endangered, threatened, or rare. One species, the California condor (*Gymnogyps californianus*), which is not currently found in the wild, used oak woodlands extensively as foraging grounds. The grizzly bear (*Ursus horribilis*) now extirpated from California, once roamed throughout the oak woodlands. Extant species of concern include the Tehachapi slender salamander (*Batrachoceps stebbinsi*), Kern Canyon slender salamander (*B. simatus*), yellow-blotched salamander (*Ensatina eschscholtzii croceater*), San Joaquin pocket mouse (*Perognathus inornatus*), golden eagle (*Aquila chrysaetos*), prairie falcon (*Falco mexicanus*), Cooper's hawk (*Accipiter cooperii*), sharp-shinned hawk (*A. striatus*), and spotted owl (*Strix occidentalis*). This list is not exhaustive, but demonstrates the diversity of species whose populations may be further imperiled by alterations to their environment. Undoubtedly, more intensive study of wildlife in oak woodlands will reveal additional species of concern.

Activities and Roles of Wildlife

Traditionally, considerations of vertebrate wildlife by state resource agencies have emphasized game species, some of which are not native to California such as feral pigs (*Sus scrofa*) and wild turkeys (*Meleagro gallopavo*). Game species have measurable economic and social values, particularly with regard to the public's willingness to pay to hunt them. It can be argued, however, that their value is no greater than that of lesser-known nongame species. In fact, well over ninety percent of wildlife species are nongame. The activities of nongame wildlife (with exception of exotic species) are integral to the maintenance of the functions and processes of oak-woodland ecosystems. Each species is part of complex food webs through which energy flows and nutrients are cycled. Further, many species influ-

ence, either directly or indirectly, the structure and composition of the flora through herbivory, seed dispersal, nest building, or other activities. Thus, activities of nongame (and game) species underlie the very existence of oak woodlands. Without these species and their complex relationships, oak woodlands would not exist as we know them today.

A widely held belief among wildlife specialists is that acorns are the main source of food for wildlife in oak woodlands. Although acorns are the most obvious food in oak woodlands, they are by no means the only source of food. Some prominent animals that use acorns are the mountain quail (*Oreortyx pictus*), band-tailed pigeon (*Columba fasciata*), acorn woodpecker (*Melanerpes formicivorus*), scrub jay (*Aphelocoma coerulescens*), Beechey ground squirrel (*Spermophilus beecheyi*), and black-tailed deer (*Odocoileus hemionus*). Of the species that use acorns, Joseph Grinnell, noted biologist and naturalist, concluded that "*. . . the successive belts of valley oaks, blue oaks, golden oaks, black oaks, and huckleberry oaks, on our western mountain sides, as relying, most especially for that part of their dispersal . . . entirely upon their bird and mammal associates.*" He based this conclusion largely on his observations of scrub jays and ground squirrels, which cached acorns hundreds of yards from the trees on which they grew. Acorn woodpeckers similarly can move acorns large distances from their place of origin. Such dispersal of acorns can have obvious effects in influencing the distribution, structure, composition, and even existence of oak woodlands.

The vast majority of wildlife species, however, do not eat acorns at all but rely on other foods associated with oak woodlands. The foraging activities of these animals are as important to oak woodlands as are those of animals that eat acorns. For example, fruits of redberry (*Rhamnus crocea*), coffeeberry (*R. californicus*), buckbrush (*Ceanothus cuneatus*), manzanitas (*Arctostaphylos* spp.), toyon (*Heteromeles arbutifolia*), mistletoe (*Phoradendron* spp.), and many other plants are readily consumed by many types of wildlife. Often the seeds from these fruits are egested and dispersed to new locations. Deer and rabbits browse oaks and shrubs, altering the shapes of these plants. If browsing is particularly severe, the plant can die. Small rodents and ground-foraging birds feed heavily on the seeds of grasses and forbs, influencing the herbaceous understory. Most birds and many reptiles and amphibians forage on plants rarely, if at all, as arthropods comprise the major part of their diets. Although it has never been shown that these animals can significantly depress numbers of insects during an outbreak, they are known to keep insects at low or endemic levels. Thus, the foraging behaviors of these insectivores may prevent epidemic proportions of an insect potentially dangerous to oaks.

Recent exclosure experiments suggest that predation on acorns and seedlings by small mammals is a major contributing factor to the lack of regeneration by some species of oaks, notably blue oak (*Quercus douglasii*), valley oak (*Q. lobata*), and Engelmann oak (*Q. Engelmannii*). These results should be interpreted cautiously, because exclosures exclude most animals, both vertebrate and invertebrate, and not just small mammals from the acorns or seedlings. Further, no attempt has been made to quantify the effect of the treatment (i.e., the exclosure) on modifying the environment. A modified microclimate within an exclosure may provide enhanced conditions for seedling success rather than simply excluding possible predators.

On the other hand, the role of small mammals as dispersers of spores of hypogeous (below ground), mycorrhizal fungi may outweigh any perceived negative impacts on regeneration. These fungi attach to the roots of plants and enhance the uptake of inorganic nutrients from the soil to the plants. Studies in Oregon by Chris Maser and others have shown that many small mammals eat fungi and disperse the spores through their feces. Spores are then leached into the soil following rain, where they attach to new roots. If these spores attach to the roots of seedlings or saplings, the ultimate effect by small mammals on regeneration can be beneficial. Research into role of small mammals as dispersers of mycorrizal fungi in oak woodlands will be an important step in our understanding of oak woodland ecology.

Activities of wildlife are strongly influenced by the activities of other animals. Competition within and between species over a limited resource may cause species to use different resources or possibly to emigrate to a new location. The presence of a predator may cause the prey species to alter activities to avoid the predator; if not, the prey population may be decimated by the predator.

Not all activities of a species impose negative impacts on other animals. Some activities of wildlife are, in fact, beneficial to other species. An example is a "keystone species." A keystone species is one whose activities provide favorable conditions for other species. A study of cavity-nesting birds at the San Joaquin Experimental Range, Madera County, by Jeffrey Waters of Humboldt State University, suggested that the acorn woodpecker may be a keystone species. In many oak woodlands, acorn woodpeckers are the most abundant primary cavity-nesting species. Primary cavity nesters are those that excavate their own holes for nest and roost sites. Generally, one or more cavities are excavated each year by a group of these woodpeckers. Frequently, cavities used one year are abandoned in subsequent years. The abandoned cavities, however, do not go unused. Numerous secondary cavity nesters, species that are unable to excavate their own cavities, use abandoned acorn woodpecker holes. Some of these secondary cavity nesters are the plain titmouse (*Parus inornatus*),

More than 300 vertebrate species are known to use oak dominated woodlands for reproduction including this California black-tailed deer.

western bluebird (*Sialia mexicana*), ash-throated flycatcher (*Myiarchus cinerascens*), house wren (*Troglodytes aedon*) and violet-green swallow (*Tachycineta thalassina*). Another species, the exotic European starling (*Sturnus vulgaris*), is also a secondary cavity nester and may compete for cavities with native wildlife if cavities are in limited supply. Thus, the historic numbers of acorn woodpeckers using a location may influence the number of secondary cavity nesters, and the number of starlings may have negative effects on numbers of native secondary cavity nesters.

Spatial and Temporal Patterns

Much of the faunal diversity in oak woodlands is related to spatial differences in the vegetation. Seventeen species of oaks and many hybrids are found in California, covering fifteen to twenty percent of the state's land base from the northern to the southern boundaries. Consequently, oaks and associated animals are found in many diverse environments differing in climate, physiognomy, and plant associations. These different configurations of resources provide suitable conditions for different assemblages of wildlife. Some species are highly specialized to conditions occurring in restricted locations. For example, we have found black-bellied slender salamanders (*Batrachoceps nigriventris*), California slender salamanders (*B. attenuatus*), and yellow-blotched salamanders mainly in association with canyon (*Quercus chrysolepis*) and interior (*Q. wislizenii*) live oaks. These oaks are frequently found as a continuous canopy on mesic, north-facing slopes. Furthermore, the persistent leaf litter under these sclerophyllous oaks provides a constant source of cover. Few salamanders are found on drier south-facing slopes. Conversely, many reptiles, such as the western fence lizard (*Sceloporus occidentalis*), side-blotched lizard (*Uta stansburiana*), western skink (*Eumeces skiltonianus*), and Gilbert's skink (*E. gilberti*) inhabit these drier oak woodlands and are rarely found in live oak stands.

We have found California spotted owls (*Strix occidentalis*) in canyon live oak stands of the Tehachapi Mountains. Studies by Cameron Barrows and William LaHaye also found California spotted owls in similar habitats in other southern California mountain ranges. Recent studies by Donald Neal and George Steger have found California spotted owls breeding in blue oak-grey pine (*Pinus sabiniana*) woodlands of the foothills of the central Sierra Nevada.

Populations of many species of wildlife shift seasonally or yearly. Many birds that breed in oak woodlands migrate to a different location following breeding. Migrations may involve relatively short distances, such as in altitudinal shifts, or long distances, such as across continents. Just as some species leave oak woodlands for the winter, others occupy them only during the winter. Many of the birds that migrate to oak woodlands during winter are ground-foraging granivores such as rufous-sided towhee (*Pipilo erythrophthalmus*), dark-eyed junco (*Junco hyemalis*), and golden-crowned sparrow (*Zonotrichia atricapilla*). They take advantage of abundant seed crops from grasses and forbs. Black-tailed deer often migrate down slope from higher elevations to feed on the new acorn crop and to escape the harsher winter environment of their summer ranges. Year-round residents shift patterns of resource use with changing conditions. Plain titmice, for exam-

ple, glean insects from foliage of most species of oaks during the breeding season but are restricted to gleaning from leaves of live oaks during the late fall and winter, when most deciduous trees are leafless. They compensate, in part, by foraging more on the bark of trees by gleaning, pecking, and probing to capture insect prey.

The complex relationships that exist within oak ecosystems are not static through time and space. In fact, our research has clearly shown that distributions, abundances, and resource use vary among years, seasons, and localities. The implication of these results is that all oak woodland cannot be managed the same way and certainly not in isolation. Moreover, providing requirements for breeding does not ensure adequate resources for animals during non-breeding periods. Thus, management of wildlife in oak woodlands cannot be based solely on information from one place and time but must reflect long-term data collected from many different sites representative of the variations in environmental conditions occurring in oak woodlands.

Management Implications and Research Needs

Management of wildlife in oak woodlands requires an ecosystem approach. Oak woodlands consist not only of trees, but also of shrubs, leaf litter, grasses, forbs, downed woody debris, and countless other biotic and abiotic components. These components are interrelated; thus, alteration of one will affect the others. Urbanization, for example, can impact oak woodlands in many ways. Cutting trees reduces canopy closure that, in turn, changes the light regime, microclimate, shrub density, downed woody debris, litter layer, and many other factors. The animals associated with these stands—from salamanders that inhabit the litter to deer that consume acorns, graze grasses and forbs, and browse shrubs—are impacted differently by such changes. Further, removing snags and dead limbs that pose potential hazards to buildings reduces nest sites for cavity nesting birds and a continued supply of downed woody material, an important habitat component for many amphibians, reptiles, and small mammals. Fragmentation of oak woodlands resulting from reduced stand sizes and increased distances between stands may restrict gene flow of plants and animals, decreasing genetic diversity, and possibly leading to extinctions of species. Concomitant with urbanization are introductions of exotic animals such as house sparrows (*Passer domesticus*), rock doves (*Columba livia*), dogs (*Canis familiaris*), and cats (*Felis domesticus*), which compete with or prey upon native wildlife. The preceding examples are obvious effects of urbanization; subtle effects undoubtedly occur as well.

Management must be based on accurate information that details the ecologies of all animals found there and also predicts effects of environmental change on their populations. Presently, these data are lacking for most species. Research by California Department of Fish and Game has emphasized game as well as threatened, endangered, and rare species. A large part of their game management program entails monitoring acorn production. This research is certainly well directed but is too limited in scope. Clearly, greater emphasis must be placed on the numerous nongame species and the resources they require if their populations are to be managed effectively.

Current management of wildlife in oak woodlands is largely based on the California Wildlife-Habitat-Relationships (WHR) data base. The information contained within the WHR system is mostly derived from anecdotal information provided by early naturalists. The system is in an early stage of development, and recent tests of the WHR data base indicate that it must be revised before it can be used for wildlife management. The data needed are not easily obtained and require extensive and intensive fieldwork. This research cannot

Western fence lizards are among several lizards and skinks that inhabit drier oak woodlands such as on south facing slopes or inland.

proceed in a piecemeal fashion, but must follow a rigorous, logical agenda. The first step is to detail distributions and habitat associations of wildlife found in oak woodlands. More intensive research should follow to determine specific habitat needs of each species. Once this information is obtained, carefully planned experiments can be performed to determine impacts of various environmental perturbations on the populations, reproductive success, and survival rates of different wildlife species. It is imperative that these data are obtained to assure the conservation of wildlife in oak woodlands and, indeed, of oak woodlands as we know them today.

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Both the coyote (*Canis latrans*) (above) and the bobcat (*Lynx rufus*) are part of the oak woodland ecosystem and influence the structure and composition of the flora and fauna through their feeding and hunting activities.