

Proceedings of a Symposium on Oak Woodlands: Ecology, Management, and Urban Interface Issues

March 19–22, 1996 San Luis Obispo, California

Norman H. Pillsbury Jared Verner William D. Tietje

Technical Coordinators

Contents

Preface	viii
Acknowledgments	xii
Plenary Addresses	1
California's Oak Woodlands: Where We Have Been, Where We Are, Where We Need to Go	3
<i>Jack Ward Thomas</i>	
A California Cattleman's Perspective on the Oak Hardwood Issue	11
<i>Richard O'Sullivan</i>	
Resolving Oak Woodland Issues in California	17
<i>Terry Barlin Gorton</i>	
The Network Solution	21
<i>Tharon O'Dell</i>	
Wake Up, California!	27
<i>Janet S. Cobb</i>	
Why the System Does Not Work, and How to Fix It	35
<i>Richard A. Wilson</i>	
Plenary Presentations	39
Oak Woodland Management in the Bureau of Land Management	41
<i>Ed Haste</i>	
The Role of the California Department of Fish and Game in the Conservation of California's Oak Woodlands	43
<i>Terry M. Mansfield</i>	
Management of Oaks Within the Pacific Southwest Region	45
<i>G. Lynn Sprague</i>	
Ecosystem-Based Planning on a Watershed Approach	49
<i>Charles W. Bell</i>	
CCA History and Policy for Hardwood Range Management	51
<i>Kenneth J. Zimmerman</i>	
Hardwood Protection Needs to Come from Leadership, Not Regulation	53
<i>Richard A. Wilson</i>	
Oak Research Needs	55
<i>Enoch F. Bell</i>	

**Pacific Southwest
Research Station**

USDA Forest Service
General Technical Report
PSW-GTR-160

December 1997

Technical Papers

SECTION I: Ecology and Regeneration	57
<i>Timothy R. Plumb and Charles L. Bolsinger, Section Coauthors and Consulting Editors</i>	
Section Overview—Progress on the Ecology and Silviculture of California Oaks During the Past 17 Years	59
<i>Timothy R. Plumb</i>	
Section Overview—Challenges of Inventorying and Monitoring Oak Woodlands	61
<i>Charles L. Bolsinger</i>	
Soil Characteristics of Blue Oak and Coast Live Oak Ecosystems	65
<i>Denise E. Downie and Ronald D. Taskey</i>	
The Influence of Epiphytic Lichens on the Nutrient Cycling of a Blue Oak Woodland	75
<i>Johannes M. H. Knops, Thomas H. Nash III, and William H. Schlesinger</i>	
Woody Root Biomass of 40- to 90-Year-Old Blue Oaks (<i>Quercus douglasii</i>) in Western Sierra Nevada Foothills.	83
<i>Catherine S. Millikin, Caroline S. Bledsoe, and Jerry Tecklin</i>	
Rooting Responses of Three Oak Species to Low Oxygen Stress	91
<i>Karel A. Jacobs, James D. MacDonald, Alison M. Berry, and Laurence R. Costello</i>	
Patterns of Geographic Synchrony in Growth and Reproduction of Oaks Within California and Beyond	101
<i>Walter D. Koenig and Johannes M.H. Knops</i>	
Patterns and Processes of Adaptation in Blue Oak Seedlings	109
<i>Kevin J. Rice, James H. Richards, and Steven L. Matzner</i>	
Genetic Variation in Shoot Growth, Phenology, and Mineral Accumulation of Northern and Central Sierra Nevada Foothill Populations of Blue Oak	117
<i>Joe R. McBride, Edward A. Norberg, James L. Bertenshaw, Susan Kloss, and Ahmad Mossadegh</i>	
Gene Flow Among Populations of Three California Evergreen Oaks	127
<i>Richard S. Dodd, Zara A. Rafii, and Nasser Kashani</i>	
Effects of Shade and Clipping on Coast Live and Blue Oak Seedling Mortality and Growth in California Annual Grasslands	135
<i>Pamela C. Muick</i>	
Stand-Level Status of Blue Oak Sapling Recruitment and Regeneration	147
<i>Tedmund J. Swiecki, Elizabeth A. Bernhardt, and Christiana Drake</i>	
Factors Affecting Blue Oak Sapling Recruitment	157
<i>Tedmund J. Swiecki, Elizabeth A. Bernhardt, and Christiana Drake</i>	
Growth of Blue Oak on California's Hardwood Rangelands	169
<i>Richard B. Standiford</i>	
Blue Oak Regeneration in Southern Sierra Nevada Foothills	177
<i>Ralph L. Phillips, Neil K. McDougald, Richard B. Standiford, Douglas D. McCreary, and William E. Frost</i>	
Understory-Canopy Relationships in Oak Woodlands and Savannas.	183
<i>William E. Frost, James W. Bartolome, and J. Michael Connor</i>	
Fire History of a Mixed Oak-Pine Forest in the Foothills of the Sierra Nevada, El Dorado County, California	191
<i>Scott L. Stephens</i>	
Efficacy of Herbicide Application Methods Used to Control Tanoak (<i>Lithocarpus densiflorus</i>) in an Uneven-Aged Coast Redwood Management Context.	199
<i>Douglas D. Piirto, Brenda Smith, Eric K. Huff, and Scott T. Robinson</i>	

SECTION II: Restoration 209
Douglas D. McCreary, Section Chair and Consulting Editor

Section Overview—Restoration of Oak Woodlands 211
Douglas D. McCreary

Oak Seedling Establishment by Artificial Regeneration on California Rangelands . . 213
*Theodore E. Adams, Jr., Peter B. Sands, William H. Weitkamp,
 and Marion E. Stanley*

Constraints on Germination and Emergence of Emory Oak 225
*Heather L. Germaine, Guy R. McPherson, Karin J. Rojahn,
 Alicia M. Nicholas, and Jake F. Weltzin*

An Evaluation of Coast Live Oak Regeneration Techniques 231
Timothy R. Plumb and Michael D. De Lasaux

Effects of Seedling Protectors and Weed Control on Blue Oak Growth
 and Survival 243
Douglas D. McCreary and Jerry Tecklin

Sunshine Canyon Mitigation Oaks—A Success Story 251
Ralph S. Osterling

Status of Transplanted Coast Live Oaks (*Quercus agrifolia*) in Southern
 California 257
Rosi Dagit and A. James Downer

Rehabilitation of a Blue Oak Restoration Project 267
Jerry Tecklin, J. Michael Connor, and Douglas D. McCreary

Restoration Management of Northern Oak Woodlands 275
Marla S. Hastings, Steve Barnhart, and Joe R. McBride

A California Black Oak Restoration Project in Yosemite Valley, Yosemite
 National Park, California. 281
Susan L. Fritzke

Evaluation of Techniques and Costs for Valley Oak Riparian Forest
 Restoration on the Sacramento River 289
F. Thomas Griggs and Daryl R. Peterson

SECTION III: Range and Livestock Relations 297
William E. Frost, Section Chair and Consulting Editor

Section Overview—Range and Livestock Relations 299
William E. Frost

Effects of Cultural Inputs on Survival and Growth of Direct Seeded and
 Naturally Occurring Valley Oak Seedlings on Hardwood Rangeland 301
Elizabeth A. Bernhardt and Tedmund J. Swiecki

Effects of Livestock Grazing on Blue Oak Saplings 313
*Henricus C. Jansen, Richard R. Snow, Gregory A. Treber,
 and Fremont L. Bell*

Effects of Blue Oak Canopy on Annual Forage Production 321
J. Michael Connor and Bob L. Willoughby

The Influence of Cattle Grazing on California Ground Squirrels in a Blue
 Oak Savanna 327
James W. Bartolome

Preliminary Results from the Evaluation of Different Seasons and
 Intensities of Grazing on the Erosion of Intermittent Streams at
 the San Joaquin Experimental Range 331
*Royce E. Larsen, Melvin R. George, Neil K. McDougald,
 Kenneth W. Tate, and Kenneth O. Fulgham*

Livestock Grazing and Riparian Habitat Water Quality: An Examination of Oak Woodland Springs in the Sierra Foothills of California	339
<i>Chris G. Campbell and Barbara Allen-Diaz</i>	
Influence of Supplemental Feeding Sites on Use of Hardwood Rangeland Riparian Areas by Cattle	347
<i>William E. Frost and Neil K. McDougald</i>	
SECTION IV: Wildlife Habitat Relations and Habitat Fragmentation . . .	351
<i>Barrett A. Garrison and Frank W. Davis, Section Coauthors and Consulting Editors</i>	
Section Overview—Wildlife Habitat Relations and Habitat Fragmentation in California’s Hardwood Rangelands	353
<i>Barrett A. Garrison and Frank W. Davis</i>	
Characteristics of California Spotted Owl Nest Sites in Foothill Riparian and Oak Woodlands of the Southern Sierra Nevada, California	355
<i>George N. Steger, Gary E. Eberlein, Thomas E. Munton, and Kenneth D. Johnson</i>	
Characteristics of Red-tailed Hawk Nest Sites in Oak Woodlands of Central California	365
<i>William D. Tietje, Peter H. Bloom, and Justin K. Vreeland</i>	
Small Nocturnal Mammals in Oak Woodlands: Some Considerations for Assessing Presence and Abundance	373
<i>William F. Laudenslayer, Jr., and Roberta J. Fargo</i>	
Bird Communities in Grazed and Ungrazed Oak-Pine Woodlands at the San Joaquin Experimental Range	381
<i>Jared Verner, Kathryn L. Purcell, and Jennifer G. Turner</i>	
Relative Abundance and Habitat Associations of Vertebrates in Oak Woodlands in Coastal-Central California	391
<i>William D. Tietje, Justin K. Vreeland, Nancy R. Siepel, and JoAnn L. Dockter</i>	
Developing a Conservation Strategy for Southern California Forests and Woodlands	401
<i>John R. Stephenson, Devere A. Volgarino, Greg A. Nichols, and Thomas C. White</i>	
A Post-Hoc Assessment of the Impacts to Wildlife Habitat from Wood Cutting in Blue Oak Woodlands in the Northern Sacramento Valley . . .	411
<i>Barrett A. Garrison and Richard B. Standiford</i>	
Contribution of Downed Woody Material by Blue, Valley, and Coast Live Oaks in Central California	423
<i>William D. Tietje, Tristan C. Berlund, Sergio L. Garcia, Christopher G. Halpin, and Wayne A. Jensen</i>	
Design Recommendations for Point Counts of Birds in California Oak-Pine Woodlands: Power, Sample Size, and Count Stations Versus Visits	431
<i>Paul A. Aigner, William M. Block, and Michael L. Morrison</i>	
SECTION V: Wood Products and Utilization	441
<i>John R. Shelly, Section Chair and Consulting Editor</i>	
Section Overview—Wood Utilization	443
<i>John R. Shelly</i>	
An Examination of the Oak Woodland as a Potential Resource for Higher-Value Wood Products	445
<i>John R. Shelly</i>	

California Black Oak—From Firewood to Lumber, the Lumber
Recovery Story 457
Eni C. Lowell and Marlin E. Plank

Tree Volume Equations for 10 Urban Species in California 465
Norman H. Pillsbury and Jeffrey L. Reimer

A Literature Review of California Domestic Cork Production 479
William H. Brooks

SECTION VI: Urban Forestry Interface Issues 485
Rowan A. Rowntree, Section Chair and Consulting Editor

Section Overview—California Oaks in the Urbanizing Forest Ecosystem. . . . 487
Rowan A. Rowntree

Using Population Distribution Forecasts and GIS Technology to
Assess Potential Hardwood Loss in the Northern Sacramento Valley . . . 491
Charles W. Nelson and Mark Radabaugh

A Development in Harmony with Nature? 499
James R. Vilkitis

Monitoring Survival and Vigor of Specimen Valley Oaks Influenced
by Urban Development Sites 515
Douglas V. Nickles

Managing Development in California’s Oak Woodlands 521
Bruce W. Hagen

Improved Methods to Evaluate the Impact of Subdivisions on
Wildlife in Oak-Dominated Woodlands in California 527
Dale Sanders and Michael Baefsky

SECTION VII: Damaging Agents and Protection 539
Tedmund J. Swiecki, Section Chair and Consulting Editor

Section Overview—Damaging Agents and Oak Ecology:
Management Implications 541
Tedmund J. Swiecki

The California Oak Disease and Arthropod (CODA) Database 543
Tedmund J. Swiecki, Elizabeth A. Bernhardt, and Richard A. Arnold

The Effect of Low Oxygen Stress on *Phytophthora cinnamomi* Infection
and Disease of Cork Oak Roots 553
*Karel A. Jacobs, James D. MacDonald, Alison M. Berry, and
Laurence R. Costello*

Wildfire and Oak Regeneration at the Urban Fringe. 559
Joan L. Schwan, Herb Fong, and Hilary K. Hug

SECTION VIII: Economics, Policy, and Planning 565
Richard P. Thompson, Section Chair and Consulting Editor

Section Overview—Economics, Policy, and Planning 567
Richard P. Thompson

The Integrated Hardwood Range Management Program: Education
and Research as a Conservation Strategy 569
Richard B. Standiford and James W. Bartolome

An Ecosystem-Based Approach to Valley Oak Mitigation 583
Marcus S. Rawlings and Daniel A. Airola

Factors Contributing to Land-Use Change in the Hardwood Rangelands
of Two Central Sierra Nevadan Counties 593
Sharon G. Johnson

Management of California Oak Woodlands: Uncertainties and Modeling	603
<i>Jay E. Noel and Richard P. Thompson</i>	
Estimating Value Contribution of Tree and Stand Condition	613
<i>R. Joss Hanna, Richard P. Thompson, Douglas D. Piirto, and Jay E. Noel</i>	
Poster Papers	623
<i>John M. Bryant, Technical Chair</i>	
Overview—A Bird’s-Eye View of the Poster Papers	625
<i>John M. Bryant</i>	
California’s Oak Woodlands Revisited: Changes in Owners, Use, and Management, 1985 to 1992	626
<i>Lynn Huntsinger</i>	
Profile of the California Hardwood Industry	631
<i>John R. Shelly</i>	
The Utilization of Nontimber Forest Resources to Create Special Forest Products	636
<i>Dorothy Mockus Lubin</i>	
Mortality and Growth Rates of Seedlings and Saplings of <i>Quercus agrifolia</i> and <i>Quercus engelmannii</i> : 1990-1995	642
<i>Dawn M. Lawson, Paul H. Zedler, and Leslie A. Seiger</i>	
Monitoring Fire Injury in Canyon Live Oak with Electrical Resistance	646
<i>Marcia G. Narog, Timothy E. Paysen, Bonni M. Corcoran, and Miguel A. Zavala</i>	
Seeds That Fly on Feathered Wings: Acorn Dispersal by Steller’s Jays	648
<i>Marilyn A. Fuchs, Pam G. Krannitz, Alton S. Harestad, and Fred L. Bunnell</i>	
Competitive Effects of Alfalfa on Survival, Growth, and Water Relations of <i>Quercus lobata</i> Seedlings	651
<i>Jean G. Hubbell</i>	
The Effects of Native Soils on Engelmann Oak Seedling Growth	657
<i>Thomas A. Scott and Nanette L. Pratini</i>	
Conservation Reserve Program (CRP) Oak Regeneration Study	661
<i>William H. Weitkamp, Sally L. Yoshida, and William D. Tietje</i>	
<i>Quercus wislizenii</i> Growth Rings	664
<i>Scott D. White</i>	
Pruning Oak Resprouts to Enhance Growth	667
<i>Sheila J. Barry, Ronald S. Knight, and Douglas D. McCreary</i>	
Assessment of a Prescribed Burning Project: 1987-1995	671
<i>Neil K. McDougald and William E. Frost</i>	
Acorn Collection, Storage, Sorting, and Planting for the Establishment of Native Oaks Without Supplemental Irrigation	678
<i>Ronald W. Motz</i>	
The Diet of California Spotted Owls in Riparian Deciduous and Oak Habitats of the Southern Sierra Nevada	683
<i>Thomas E. Munton, Kenneth D. Johnson, George N. Steger, and Gary E. Eberlein</i>	
Poster Abstracts	689
<i>John M. Bryant, Technical Chair</i>	
Overview—A Bird’s-Eye View of the Poster Abstracts	691
<i>John M. Bryant</i>	

Oak Woodlands and Prescribed Burning—An American Indian Perspective 692
Linda Moon Stumpff

Effect of Forest Soil Inoculum on Mycorrhizal Root Development and Growth of Valley Oak Seedlings 692
Jennifer Berman and Caroline Bledsoe

Soil Water Potentials Provide Evidence of Hydraulic Lift and Oak Root Activity in a California Blue Oak Woodland 693
Caroline S. Bledsoe and Catherine S. Millikin

Effects of Tree Shelters on Growth Rates of Directly Seeded California Oaks 693
Herb Fong, Robin Bayer, and Joan L. Schwan

Comparisons of Water Stress and Stomatal Conductance in Different Size Classes of *Quercus douglasii* from Different Sites 694
Steven L. Matzner, Kevin J. Rice, and James H. Richards

Population Structure and Clonal Variation in *Quercus chrysolepis* Liebm. 694
Arlee M. Montalvo, Susan G. Conard, M. Thompson Conkle, and Paul Hodgskiss

Practical Methods of Regenerating Oaks on a Cattle Ranch 695
George R. Work

A Model Nonpoint Source Management Plan for Hardwood Rangeland. 696
J. M. Connor and Melissa Joyce

Restoration of California Walnut Woodlands at the Urban-Wildland Interface in Southern California 697
Steve Narwath, Ronald D. Quinn, James Roberts, and Gabor Bihari

Pacific Gas and Electric Company’s Vegetation Management Program 698
Heidi Lian

Conserve Oak Woodlands 698
M. Christine Lomas, Norman H. Pillsbury, and Amy Larson

The Effect of Sociological Factors, Attitudes, and Beliefs on Private Oak Woodland Management 699
Barbara S. Kruger and Richard P. Thompson

Symposium Wrap-Up 701

 The New California 703
 Daniel R. Walters

Author Index 711

Index 717

Preface

These proceedings concern California's 10 million acres of oak woodlands—the predominant vegetation type in the most inhabitable areas of the most populous and fastest-growing state in the nation. Oak woodlands encircle the Central Valley and extend southward along the coast to our border with Mexico. They occur in 54 of California's 58 counties, and 22 counties include at least 100,000 acres of oak woodlands. Since European settlement, the oak woodlands have been managed primarily for livestock production. Currently, about 80 percent are privately owned, and their primary use remains livestock production. But this enterprise is being threatened because greatly increased value has been placed on the woodlands within the past 20 years for esthetics, wildlife habitat, watershed functioning, maintenance of water quality, erosion and sediment control, outdoor recreation, and production of wood and specialty products.

During the first three quarters of this century, the primary change in extent and composition of oak woodlands was a result of conversion to rangeland and agricultural production. More than one million acres were thinned or cleared of oaks to enhance areas for grass production for livestock or to increase water yield. These practices may have been misguided. In the mid-1980's, residential development, which may fragment formerly contiguous woodlands, replaced rangeland conversion as the primary cause for loss of oak woodlands. Recent concern in coastal California has focused people's attention on the conversion of oak woodlands to vineyards. During the past several years, increased demand for wine grapes has driven up their value, resulting in unprecedented vineyard development. Demands on the oak-covered valleys and foothills are expected to continue—even to accelerate—as a result of demographic pressure and the social and economic needs of more than 30 million Californians. Population and economic expansion will continue to fuel concern for the well-being of the woodlands.

This is the fourth in a series of statewide symposia to focus attention on oak woodlands. The first was held at Claremont, California, in 1979. Each symposium has attempted to synthesize the state of our knowledge at the time. The second symposium, convened in San Luis Obispo in 1986, focused on issues of oak regeneration and the potential effects of land use on the oak resource. That symposium served as a springboard for the newly formed University of California's Integrated Hardwood Range Management Program (IHRMP), charged with the mission of maintaining California's oak woodlands through applied research and public outreach and education. The third symposium, held in Davis in 1990, provided the latest knowledge on the inventory, ecology, uses, and management of oak woodlands. The potential effects of habitat fragmentation and the role of local policy and planning efforts in maintaining oak woodlands were new research and education directions emphasized at that symposium. Building on the past three symposia and continued development of research information and education programs, this—the 1996 symposium—hosted nearly twice the attendance as the first symposium and was held once again on the campus of California Polytechnic State University in San Luis Obispo.

Since the first symposium, we have made great advances in our understanding of the functioning of the woodland ecosystems and in developing sound management strategies for woodland owners and managers. But this important work is not done. California added 6 million people to its population during the 1980's. Further increases of 6 million per decade are projected well into the next century. Accompanying this phenomenal growth has been a substantial movement of the state's population from large metropolitan centers to formerly rural areas. As a result, challenges at the urban-wildland interface

have been accelerating for years; these promise to be among the toughest issues that we must address in our future management of the woodlands.

Statewide, many groups and agencies are seeking solutions to the issues associated with oak woodlands. They face the challenge of maintaining the ecological values of the woodlands while maintaining the livelihood of the present owners and a way of life for California's residents. Several partnerships have developed in this process. The **Integrated Hardwood Range Management Program (IHRMP)** has worked directly with the California Department of Forestry and Fire Protection and the California Department of Fish and Game on research and education programs. Research funded by this partnership has produced more than 150 technical papers and 50 extension education leaflets. **California Polytechnic State University, San Luis Obispo**, has a long and productive history of work on oak woodlands, especially on oak distribution, growth, and yield. Its Natural Resources Management Department teaches the only course devoted to the ecology and management of oak woodlands in the western United States. **Humboldt State University (Arcata, Calif.)** has given attention to wildlife issues in oak woodlands and, recently, **Chico State University (Chico, Calif.)** began a geographic information systems (GIS) program on detecting change in oak woodlands. The **California Oak Foundation** assists people working to improve oak conservation policies; enables youth to become responsible stewards of California's oak woodlands; and has reported on financial burdens, such as estate taxes, that landowners and their heirs face in keeping rural land in the family through the generations. The **USDA Forest Service's Pacific Southwest Research Station (PSW)** has increased its emphasis on research into ecological relations in oak woodlands. Recently, the **Station's Forest Fire Laboratory in Riverside, California**, began a program to address the effects of wildfire and prescribed burning in oak woodland. All of these organizations have worked in partnership to produce workshops, symposia, meetings, and one-on-one contacts to increase the awareness of oak woodland values among landowners, land managers, and city and county planners. Continued attempts are needed to develop other partnerships that seek amicable solutions to issues arising over oak woodlands.

This symposium attempted through the plenary presentations to educate the public about the diverse views on oak woodlands that are represented by different groups and management agencies. Themes of the plenary papers emphasized the need for (1) developing partnerships to address common goals, rather than creating obstacles that lead to divisive viewpoints, (2) financial relief for woodland owners to protect their way of life and the public's interest, in return for assurances of long-term land use and stewardship, and (3) better science and education to demonstrate to the public the multiple values of the State's oak woodlands.

Technical sessions provided a forum for researchers, land managers, and land-use planners to share their latest research about oak woodland ecosystems in California. The technical papers, all critiqued by peers, are presented here in eight topical sections. In addition, 15 poster presentations are presented as summary papers and 11 others are presented in abstract form.

Section I—Ecology and Regeneration. The 17 technical papers in this section deal with the role of oaks and associated plant species in nutrient cycling and factors that affect regeneration, including soil characteristics, shade, and herbivores. Several new lines of research are included.

Section II—Restoration. This section emphasizes efforts to restore stands of oaks in areas from which they have been eliminated. It is clear that restoration

has gone beyond research and experimentation to direct implementation. Information is included on restoration of Engelmann, blue, valley, black, and Oregon white oaks.

Section III—Range and Livestock Relations. Seven papers discuss the influence of livestock grazing on ground squirrels, water quality in oak woodland riparian habitats, and the effects of season and intensity of grazing on erosion in intermittent streams.

Section IV—Wildlife Habitat Relations and Habitat Fragmentation. Presenters of nine papers report results of studies on the ecology and management of oak woodland amphibians, reptiles, birds, and mammals. Some papers show that we are now entering a phase of controlled experiments on the effects of management practices on wildlife in the oak woodlands. Habitat fragmentation is a new and emerging research area in the oak woodlands, an area that will be markedly enhanced by advances in geographic information systems (GIS) and spatial statistics.

Section V—Wood Products and Utilization. Four papers focus attention on the many uses of oak wood and oak woodlands: firewood, lumber, and specialty forest products, including cork from the introduced cork oak. Papers do not advocate the harvesting of large numbers of trees from the oak woodlands nor the need to investigate all woody materials as potential sources for wood products. The ultimate goal is to encourage sustainable use of the oak woodlands.

Section VI—Urban Forestry Interface Issues. Five papers provide information on the effects of development on oak trees and oak woodlands and highlight the need for long-term monitoring to evaluate the success of mitigation efforts. Several spatial scales of planning are needed to preserve oaks and associated habitats at the urban-wildland interface.

Section VII—Damaging Agents and Protection. Three technical papers provide information on wildfire, oak tree infection and disease, and the California Oak Disease and Arthropod (CODA) database. Since the last symposium, research has not emphasized the role of damaging agents, diseases, and insects on oaks, although this should not be interpreted as a lack of importance of these agents. Diseases are a major source of natural mortality among mature oaks. Insects, important as damaging agents, constitute the largest component of biological diversity in oak woodlands.

Section VIII—Economics, Policy, and Planning. Five papers represent the diversity of planning, legislation, and value approaches to managing oak woodlands. One important message that emerged: through research and education, we can help our elected officials conserve oak woodlands. Work is under way to provide policy makers a tool to understand the effectiveness of policy decisions on the economic forces that are affecting oak woodlands.

Information presented at this symposium indicates that concerns about the status of oak woodlands and solutions to the challenges are not static. Instead, they have been and will continue to be driven by California's demographic, economic, social, and political events, and by our understanding of the ecology of oak woodland ecosystems. We are presently less concerned about regeneration of blue oaks than we were in 1979, at the first oak symposium. We have developed regeneration techniques to apply where human intervention is needed. We also have realized that the apparently low level of regeneration by blue oaks in some areas may be in accord with nature's strategy to maintain this species. The same cannot be said about the state of valley oak regeneration, however. We now know much about what constitutes good habitat for wildlife species that use oak woodlands, but we know less about where and how much of that habitat is needed to sustain the ecological system and maintain its full spectrum of biological diversity. We are more concerned today about residential intrusion

into oak woodlands and associated habitat fragmentation, and the degradation of economic, esthetic, and ecological values. The recent increase in conversion of oak rangelands to vineyards, driven by the increasing value of wine grapes, brings new challenges for the maintenance of wildlife populations, soil stability, riparian integrity, and watershed functioning. This shift in the use of oak woodlands again calls for developing new partnerships, information, and applications for minimizing and mitigating environmental degradation.

What does the future hold for California's oak woodlands? To paraphrase the views of Dan Walters, who presented the closing address for the symposium: The great story of California today is the explosion of the state's population, accompanied by the shift of population from coastal metropolitan areas into formerly rural areas—especially oak woodlands. Newcomers want roads, schools, housing, shopping centers, and water. Ironically, the impetus for this movement is to escape the crush of metropolitan life, but the newcomers then want to reestablish in their new surroundings the selfsame conditions they sought to escape. How can oak trees compete with these needs and demands? And will decision makers ever face up to the population pressures that created the threats to California's ancient oaks in the first place?

One fact seems abundantly clear to us. The economic, social, political, and natural resource issues addressed in this symposium, and the three that preceded it, will not disappear soon. We are making progress, but much remains to be done.

Norman H. Pillsbury
Jared Verner
William D. Tietje

Trade names and commercial brands are mentioned in this publication solely for information. No endorsement by the U.S. Department of Agriculture is implied.

Acknowledgments

The contributions of many people were essential in making the Symposium a success. Amy Larson, Michelle Gaspar, Carolyn Shank, and John Bryant were key players in organizing people and making arrangements. The student chapter of the Society of American Foresters at California Polytechnic State University (Cal Poly) assisted with a myriad of details before, during, and after the symposium, not the least of which was handling the complexities of budgeting and accounting. An especially heavy load of organizational activities, coordination, and other essential tasks was borne by the Student Symposium Team. Additional volunteer services were generously provided by Janet Cobb and Amy Larson of the California Oak Foundation, who provided student training. Facilities for planning sessions, various logistic support, and staff services were provided by the Natural Resources Management Department and the Urban Forest Ecosystems Institute at Cal Poly, by the Integrated Hardwood Range Management Program of the University of California, Berkeley, and by the USDA Forest Service, Pacific Southwest Research Station. Rick Standiford assisted with the editing of plenary presentations and introducing the plenary speakers.

Student Symposium Team

Students from the Forestry and Natural Resources Leadership class (Norman H. Pillsbury, instructor) and the Recreation Administrative Events Planning and Management class (Carolyn B. Shank, instructor) at Cal Poly served as on-campus organizers and liaisons for the transportation, dining, advertisement, facilities, multi-media, agenda publications, session chair correspondents, student volunteer organizers, and a myriad of responsibilities associated with the production of a symposium of this magnitude. We thank these dedicated students for their hundreds of hours of class and volunteer time.

Richard A. Bate	Darien R. Nielson
Darren C. Brown	Sarah T. Pollard
Robin L. Edwards	Lucas W. Pomeroy
Tara M. Ennis	Dana L. Ryan
Michelle C. Gaspar	Michelle L. Saling
Neva L. Jarvis	Jennifer S. Schroeder
M. Christine Lomas	David K. Thompson
Tonya L. McCune	Andrea M. Warren
Allison L. Miller	

Board of Consulting Editors

Eleven scientists were responsible for technical review and editing of the papers presented at the Symposium (and subsequently published in these proceedings) and for following up with authors. These Consulting Editors moderated the sessions at the Symposium.

Charles L. Bolsinger, Research Forester
Pacific Northwest Research Station
USDA Forest Service, Portland, Oregon

John M. Bryant, Executive Director
Urban Forest Ecosystems Institute
California Polytechnic State University, San Luis Obispo

Frank W. Davis, Professor
Geography Department
University of California, Santa Barbara

William E. Frost, Natural Resources Advisor
University of California Cooperative Extension, Placerville

Barrett A. Garrison, Senior Wildlife Biologist
California Department of Fish and Game, Sacramento

Douglas D. McCreary, Natural Resources Specialist
University of California Cooperative Extension, Browns Valley

Timothy R. Plumb, Professor
Natural Resources Management Department
California Polytechnic State University, San Luis Obispo

Rowan A. Rowntree, Research Program Leader
Pacific Southwest Research Station
USDA Forest Service, Albany, California

John R. Shelly, Head, Information Services Center and Research Associate
Forest Products Laboratory, University of California, Richmond

Tedmund J. Swiecki, Principal
Phytosphere Research, Vacaville, California

Richard P. Thompson, Professor
Natural Resources Management Department
California Polytechnic State University, San Luis Obispo

We are deeply indebted to all of these individuals, groups, and organizations. Without them, this symposium could not have taken place.

*Norman H. Pillsbury
Jared Verner
William D. Tietje*

Publisher: Pacific Southwest Research Station

Albany, California
Mailing address:
P.O. Box 245, Berkeley CA
94701-0245

Forest Service
U.S. Department of Agriculture

(510) 559-6300

<http://www.psw.fs.fed.us>

December 1997

Abstract

Pillsbury, Norman H.; Verner, Jared; Tietje, William D., technical coordinators. 1997. **Proceedings of a symposium on oak woodlands: ecology, management, and urban interface issues**; 19–22 March 1996; San Luis Obispo, CA. Gen. Tech. Rep. PSW-GTR-160. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture; 738 p.

Oak woodlands, the predominant vegetation type in the most inhabitable areas of California, comprise 10 million acres in the State and have been used primarily for livestock production. Today, residential intrusion into oak woodlands results in habitat fragmentation and degradation of economic, esthetic, and ecological values. Decision makers must face up to the population pressures caused by the increasing human population in California and its shift from coastal metropolitan areas into formerly rural areas—especially oak woodlands. Newcomers want roads, schools, housing, shopping centers, and water. How can oak trees compete with these needs and demands?

Retrieval Terms: oaks, oak management, range management, regeneration, wildlife, urban interface, restoration, economics, policy

Technical Coordinators

Norman H. Pillsbury is professor and head, Natural Resources Management Department, California Polytechnic State University, San Luis Obispo, CA 93407. **Jared Verner** is chief research wildlife biologist, Forestry Sciences Laboratory, Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture, 2081 E. Sierra Ave., Fresno, CA 93710. **William D. Tietje** is natural resources specialist, Integrated Hardwood Range Management Program, Department of Environmental Science, Policy, and Management, University of California, Berkeley, CA 94720.

Symposium Sponsors

- USDA Forest Service
Pacific Southwest Research Station
Pacific Northwest Research Station
Pacific Southwest Region (Region 5),
State and Private Forestry
- California Department of Forestry and
Fire Protection
- California Polytechnic State University
Natural Resources Management
Department
Student Chapter of the Society of
American Foresters
Urban Forest Ecosystems Institute
- California Department of Fish and Game
- University of California, Berkeley,
Department of Environmental Science,
Policy, and Management, Integrated
Hardwood Range Management Program
- Pacific Gas and Electric Company
- USDA Natural Resources Conservation Service
- USDI Bureau of Land Management
- California Oak Foundation
- The Nature Conservancy of California
- Western Section of The Wildlife Society
- Coastal San Luis Resource Conservation District
- Central Coast Resource Conservation and
Development Council
- California Native Plant Society
- Garth and Ione Conlan of Conlan Ranches
- Carol Puck Erickson
- Jenny Langford
- Jeanette Maland and Gavin Liau
- Madrone Landscapes
- Norman H. Pillsbury
- Jared and Marlene B. Verner

These proceedings were published by the Pacific Southwest Research Station, USDA Forest Service, on behalf of the symposium sponsors.

The Forest Service, U.S. Department of Agriculture, is responsible for federal leadership in forestry. It carries out this role through four main activities:

- Protection and management of resources on 191 million acres of National Forest System lands
- Cooperation with state and local governments, forest industries, and private landowners to help protect and manage non-federal forest and associated range and watershed lands
- Participation with other agencies in human resource and community assistance programs to improve living conditions in rural areas
- Research on all aspects of forestry, rangeland management, and forest resources utilization.

The Pacific Southwest Research Station

- Represents the research branch of the Forest Service in California, Hawaii, American Samoa, and the western Pacific.



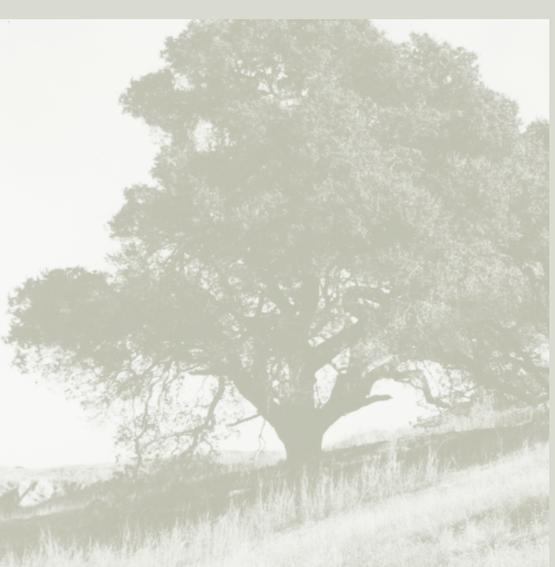
The U.S. Department of Agriculture prohibits discrimination in its programs on the basis of race, color, national origin, sex, religion, age, disability, political beliefs, and marital or familial status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communications of program information (braille, large print, audiotape, etc.) should contact the USDA Office of Communications at (202) 720-5881 (voice) or (202) 720-7808 (TDD). To file a complaint, write the Secretary of Agriculture, U.S. Department of Agriculture, Washington, DC 20250 or call (202) 720-7327 (voice) or (202) 720-1127. USDA is an equal employment opportunity employer.

United States
Department
of Agriculture
Forest Service
**Pacific Southwest
Research Station**

General Technical Report
PSW-GTR-160



Proceedings of a Symposium on Oak Woodlands: Ecology, Management, and Urban Interface Issues





United States
Department
of Agriculture

Forest Service

Pacific Southwest
Research Station

General Technical Report
PSW-GTR-160



Proceedings of a Symposium on Oak Woodlands: Ecology, Management, and Urban Interface Issues

March 19–22, 1996

San Luis Obispo, California

