

FINAL REPORT

TITLE: Tools for a changing landscape: Understanding disturbance and vegetation dynamics in northern California oak woodlands

STRATEGIC INITIATIVE PANEL(S):

Sustainable Natural Ecosystems Initiative with targets areas of:

- (i) Balancing multiple ecosystem services and biotic diversity in California's working landscapes
- (ii) Tools for land change science

INVESTIGATORS/COLLABORATORS:

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Yvonne Everett, Professor, Humboldt State University
Private and public landowners for research sites

OBJECTIVES AND TIMETABLE

This three-year study evaluated oak woodland stand dynamics and conifer encroachment in northwestern California, providing baseline information where existing research has been limited in geography and scope.

Milestones and Timetable for Year Three

Items	Start	End	Progress
Process tree cores from second field season in HSU dendrochronology laboratory (HSU graduate student and UCCE SRA).	Oct. 01, 2014	Jan. 31, 2015	The HSU graduate student has processed and assigned an age to 1800 tree cores
Prepare HSU master's thesis, for completion in summer 2015 (HSU graduate student).	Feb. 01, 2015	May 01, 2015	The HSU student completed a thesis in May 2015.
Use project data and initial reports to develop decision-support	May 01, 2015	June 30, 2015	Kathryn McGown (UCB graduate student) and Dr.'s Potts and Standiford have developed a draft

framework (M. D. Potts, UC Berkeley graduate student).			for inclusion in the 8000 series.
Develop related extension materials, including publications and contributions to the ANR oak website, drawing on project results and decision-support framework. (Y. Valachovic, R. Standiford, and collaborators).	May 01, 2015	Sept. 15, 2015	A full draft has been prepared and will be submitted in 2016 to ANR. The ANR editors have been contacted. The ANR oak website has been updated to include information on these two oak species and includes an oak story map developed by the IGIS team.
Develop policy brief for California Board of Forestry (BoF), drawing on project results and decision-support framework (all).	June 30, 2015	July 31, 2015	A policy paper was prepared and presented to the 2014 Oak Symposium (link). A joint presentation was given at the 2015 Eureka Oak Symposium by a Board of Forestry (BoF) member and Yana Valachovic to highlight the policy changes needed. Throughout the project Board members were in regular contact with this team to explore policy options. Three presentations were given to the BoF, two field trips were held that included 4 BoF members and one legislative staff member. The BoF has drafted a "Special Oak Woodland Prescription" that is in the final review stages and may be approved in June 2016. Assemblymember Jim Wood has introduced AB 1958 to address important complementary policy changes and in April 2016 the bill passed the Assembly Natural Resources Committee.
Begin planning one local workshop and a webinar series for the coming year (UCCE).	July 01, 2015	Sept. 30, 2015	Initial results were shared at a May 2013 workshop in Eureka and at the November 2014 Oak Symposium. The 2015 Eureka Oak Symposium was recorded and individual talks were posted to provide on-line availability of the information. An additional workshop will be held May 2016.
Host multi-state (CA, OR and WA) oak woodland symposium (UCCE).	Sept. 15, 2015	Dec. 31, 2015 (The date change was approved by ANR leadership June 2015)	The symposium occurred November 12-13, 2015 in Eureka. Two hundred attendees and presenters came from British Columbia, Washington, Oregon and throughout California. The symposium attendees included public and private landowners, managers, policy makers, agency representatives, and conservation groups.

TECHNICAL SUMMARY REPORT

1. What are the rate, extent, and health effects of conifer encroachment in North Coast oak woodlands, and what variables determine rates of encroachment?

Ten field sites in Oregon white oak (*Quercus garryana*) and California black oak (*Q. kelloggii*) woodlands that characterized three stages of Douglas-fir (*Pseudotsuga menziesii*) encroachment (3 plots each in early, mid and late stage per site) were sampled during the summers of 2013 and 2014 (90 plots; 9 plots per site) in Humboldt and Mendocino counties. These sites were selected across private and public lands and have compositional characteristics representative of Oregon white oak and California black oak

woodlands across the study region.

As hypothesized, the majority of the Douglas-fir encroachment has occurred recently, with the majority of fir trees establishing after 1950 (73% across all sites). Using age-to-canopy height regressions, we estimated it takes approximately 45 years (range: 20 to 83 years) for Douglas-fir trees to reach canopy co-dominance with oak trees. As a result of the current age structure and time to canopy co-dominance of Douglas-fir, we observed declines in oak growth in stands co-dominated with Douglas-fir in the last 20 to 30 years in comparison to oak-dominant stands. Likewise, the proportion of dead oak stems was also positively associated with live Douglas-fir trees for both of the primary oak species in the study. Contrary to our expectations, Douglas-fir structural attributes were not statistically associated with any of the abiotic or biotic factors we evaluated. However, there was a tendency of oak-dominant stands to be on warmer aspects and upper slope positions compared with conifer-dominant stands within individual sites. Variations in aspect and slope position (relative elevation) affect the distribution of soil moisture. Drier conditions appear to limit conifer encroachment to more mesic micro-environments. A finer evaluation of how variation in edaphic characteristics affects stand and compositional structure warrants further investigation.

For Oregon white oak, the consistently higher proportion of oak mortality and slower growth in late-stage encroachment (where conifers have overtopped oaks) compared with early-stage encroachment conditions (where oaks are dominant and firs are in the understory) suggests that expansion of conifer establishment that leads to Douglas-fir dominance in remnant unencroached woodlands is detrimental for Oregon white oak growth and survival. Once Douglas-fir overtops Oregon white oak trees in formerly oak-dominant stands, it leads to greater oak mortality and reduced oak growth. In terms of threshold levels of conifer encroachment, we found greater dead Oregon white oak stems in stands with $> 34.5 \text{ m}^2 \text{ ha}^{-1}$ Douglas-fir ($p < 0.001$), and greater numbers of dead California black oak stems in stands with $> 38.0 \text{ m}^2 \text{ ha}^{-1}$ Douglas-fir ($p < 0.001$). The higher proportion of oak tree mortality with greater conifer dominance indicates low-light conditions are highly unfavorable for both oak species.

In this study we selected a few sites that had a past conifer management history. In these sites (where landowners harvested the Douglas-fir from their oak woodlands in the 1950-1960s, largely in response to California tax policies), the removal of larger Douglas-fir appears to have positively affected oak growth from the 1940s to 1970s. The peaked release of oak growth in these stands during this time period may reflect the temporary relief from overstory conifer shading and may have extended the time it takes Douglas-fir to substantially affect oak growth. These conditions may model post-restoration conditions 50-70 years after conifer removal.

2. What oak stand structures and age structures are present within encroached areas, and how do they relate to and inform restoration targets?

Douglas-fir, Oregon white oak, and California black oak were the most abundant species across all 10 field sites. We found Oregon white oak live stem density was greater in the northernmost plots. No other abiotic variables were associated with live oak stand structure attributes. Other tree species (e.g., *Arbutus menziesii*, *Notholithocarpus densiflorus*, *Quercus chrysolepis*, *Umbellularia californica*)

cumulatively represented <7% of total stem density and basal area. The fact that the abundance and basal area of Douglas-fir were not significantly associated with any of the abiotic or biotic factors we evaluated suggests conifer encroachment into formerly pure oak stands has occurred relatively ubiquitously in recent decades at these oak woodland sites in northwestern California (i.e., not limited by site characteristics, including elevation, slope steepness, position, curvature, aspect, geographic location).

In total, 1747 trees across 10 species were sampled for age. The majority of Oregon white oak and California black oak trees dated between 1850 and 1910 (86% and 81%, respectively), and less than 1% dated after 1950. In contrast, Douglas-fir establishment occurred relatively continuously and predominantly (73%) after 1950 within and across sites. The most commonly cored trees included Douglas-fir (734 trees; median age of 43 years and a range of 6 to 142 years), Oregon white oak (629 trees; median age of 136 years and a range of 41 to >324 years), and California black oak (279 trees; median age of 136 years and a range of 45 to 301 years). Other tree species had median ages ranging between 37 to 98 years.

Seedling regeneration was dominated by Oregon white oak (average of 5,500 seedlings ha⁻¹), but was significantly less common (on average 1,000 times less) in late-stage encroachment conditions compared with early-stage conditions. California black oak was the second most common seedling, with 1,713 seedlings ha⁻¹ on average per site (range of 0 to 15,000 ha⁻¹). However, Oregon white oak and California black oak sapling densities were both low across all stand types and sites (range of 0 to 80 ha⁻¹). Douglas-fir was the third most common seedling, with 991 seedlings ha⁻¹ on average (range of 0 to 13,333 ha⁻¹), and sapling densities were substantially greater (average of 408 saplings ha⁻¹, range of 0 to 5200 ha⁻¹) than either of the oak species. Other tree species cumulatively represented <11% of the total regeneration across sites.

Where Douglas-fir trees are of high abundance and overtop oak trees, our findings suggest that Oregon white oaks are under the greatest competitive stress. It has been observed in Washington and Oregon that once overstory conifers are removed, Oregon white oak trees with crown dieback and decades of suppressed growth can respond vigorously with profuse epicormic sprouting and increased radial growth. Although this study did not quantify the effects of overstory conifer removal on oak tree growth, the observed increases in growth following past conifer harvests at selected sites during the mid-20th century suggests that oaks in conifer-dominant stands might respond well to future conifer thinning treatments in this region.

This research provides baseline information on current and historical stand dynamics in woodland ecosystems of northern California. The loss of these biodiverse native oak woodlands will require management interventions to sustain their populations in NW California.

3. How will encroachment rates and patterns shift under changing environmental and climate scenarios?

A majority of future climate scenarios predict a lengthening of summer drought conditions in California, but there is a considerable amount of uncertainty about how precipitation regimes will change in the North Coast region of California. Our assessment of growth responses to precipitation and temperature during the late 20th and early 21st centuries provided a potential forecast of oak woodland responses in

future decades for this study area. Our preliminary findings indicate neither Oregon white oak nor California black oak maintain a high sensitivity to climate variability, which suggests the ability to withstand further climate changes in the near future. Importantly, both oak species illustrated variable responses to monthly precipitation and temperature related to local geography and stand structure (i.e., early-stage conditions versus later-stage conditions where the oaks are co-dominant with Douglas-fir). As expected, both Oregon white oak and California black oak growth were more responsive to monthly precipitation than temperature. In later-stage conditions, moisture appeared to limit oak growth more than light at xeric (warm, dry) sites in comparison with mesic (cool, wet) sites. Further study into the climate-growth response of Douglas-fir compared with the oaks will improve predictions of climate-related stress and interactions with changes in forest composition and structure, though initial evaluation suggest that Douglas-fir is more responsive than the oaks to climatic changes.

4. How can we inform restoration strategies and better guide the effectiveness of limited conservation dollars?

Once the process of encroachment is underway, the relatively short time to conifer co-dominance illustrates the challenge landowners have in creating a management response to sustain their oak woodlands. We estimated it takes approximately 45 years (range of 20 to 83 years) for Douglas-fir trees to reach canopy co-dominance with oak trees. This information was used by the ANR team to develop a decision support tool to assist landowners in restoration prioritization.

DELIVERABLES

Policy relevant information

- A policy analysis was prepared and published as a part of the 6th Oak Symposium. The paper has been shared widely with the Board of Forestry and the interested public to help set the context for the proposed policy changes. Reference: Valachovic, Y., L. Quinn-Davidson, and R. Standiford. 2015. Can the California Forest Practice Rules Adapt To Address Conifer Encroachment? In Standiford, Richard B.; Purcell, Kathryn L., tech. cords. 2015. Proceedings of the seventh California oak symposium: managing oak woodlands in a dynamic world. Gen. Tech. Rep. PSW-GTR-251. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 579 p. http://www.fs.fed.us/psw/publications/documents/psw_gtr251/psw_gtr251_515.pdf

Articles/papers

Audiences for these audiences are managers, scientists, agency representatives, and policy makers.

- Livingston, A.C., J.M. Varner, E.S. Jules, J.M. Kane, and L. Arguello. 2016. Prescribed fire and conifer removal promote positive understory vegetation responses in *Quercus garryana* woodlands. *Journal of Applied Ecology*. *In press*.
- Cal Ag article on the relevance of the research project: <http://californiaagriculture.ucanr.edu/landingpage.cfm?article=ca.v069n01p12&fulltext=yes>
- Valachovic, Y., L. Quinn-Davidson, and R. Standiford. 2015. Can the California Forest Practice Rules Adapt To Address Conifer Encroachment? In Standiford, Richard B.; Purcell, Kathryn L., tech. cords. 2015. Proceedings of the seventh California oak symposium: managing oak woodlands in a dynamic

world. Gen. Tech. Rep. PSW-GTR-251. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 579 p

http://www.fs.fed.us/psw/publications/documents/psw_gtr251/psw_gtr251_515.pdf

- Schriver M. and R. Sherriff. 2015. Establishment and growth patterns of Oregon white oak and California black oak woodlands in Northwestern California. In Standiford, Richard B.; Purcell, Kathryn L., tech. cords. 2015. Proceedings of the seventh California oak symposium: managing oak woodlands in a dynamic world. Gen. Tech. Rep. PSW-GTR-251. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 579 p.
http://www.fs.fed.us/psw/publications/documents/psw_gtr251/psw_gtr251_529.pdf
- Eitzel. M.V, M. Kelly, and L. Quinn-Davidson. 2015. Lessons Learned in Historical Mapping of Conifer and Oak in the North Coast. In Standiford, Richard B.; Purcell, Kathryn L., tech. cords. 2015. Proceedings of the seventh California oak symposium: managing oak woodlands in a dynamic world. Gen. Tech. Rep. PSW-GTR-251. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 579 p.
http://www.fs.fed.us/psw/publications/documents/psw_gtr251/psw_gtr251_521.pdf
- Schriver, Madelinn. 2015. Stand and tree growth characteristics of *Quercus garryana* and *Quercus kelloggii* woodlands in northwestern California. Master's Thesis, Humboldt State University.
<http://humboldt-dspace.calstate.edu/handle/10211.3/143552>
- Eitzel, M.V., Kelly, M., Dronova, I., Valachovic, Y., Quinn-Davidson, L., Solera, J., de Valpine, P. (2016) Challenges and opportunities in synthesizing historical geospatial data using statistical models. *Ecological Informatics*. 31: 100–111 [doi:10.1016/j.ecoinf.2015.11.011](https://doi.org/10.1016/j.ecoinf.2015.11.011)
- Tools for a changing landscape: Understanding disturbance and vegetation dynamics in Northern California oak woodlands. Y. Valachovic, L. Quinn-Davidson, R. Standiford, M. Kelly, M. Potts, R. Sherriff, M. Schriver, K. McGown, M. Eitzel, M. Varner, C. Lee, G. Giusti. Poster published in the October 2015 ANR Initiatives Conference at
<http://ucanr.edu/sites/2015jointsiconference/files/221590.pdf>

Articles in development

Audiences for these articles are managers, scientists, agency representatives, and policy makers.

Special attention is given to landowners in the 8000 publication.

- For submission to UC ANR 8000. Quinn-Davidson, L., Y. Valachovic, K. McGown, C. Lee, M. Kelly, R. Standiford, M. Schriver, M. Potts, G. Giusti, R. Sherriff, M. Eitzel, M. Varner. Ecology and management of Oregon white oak and California black oak woodlands.
- Quinn-Davidson, L., M. J. Varner, et. al. Oak woodland understory response to encroachment.
- Valachovic, Y., L. Quinn-Davidson, B. Twieg, et. al. Changes in northwestern California oak woodland stand structures in response to conifer encroachment.
- Schriver, M., R. Sherriff, J. M. Varner, L. Quinn-Davidson, and Y. Valachovic. Tree establishment patterns and current stand conditions in deciduous oak woodlands of northwestern California.

Website/Web Portal

Audiences for these articles are landowners, managers, scientists, agency representatives, and policy makers.

- A website that illustrates the conservation issues with these two important oak species, now located

within ANR's existing oak website.

http://ucanr.edu/sites/oak_range/California_black_oak_and_Oregon_white_oak_Conservation/

- UCCE Humboldt oak website http://cehumboldt.ucanr.edu/Oak_Woodlands/
- UC ANR IGIS created a story map to illustrate the conifer encroachment issues at 10 field sites. Each field site has the old aerial photo paired with the most recent aerial photo.
<http://ucanr.maps.arcgis.com/apps/MapSeries/index.html?appid=b85e44975bac4992b5260981007dad51>

New tool/method/model/technology

Audiences for these audiences are landowners, managers, scientists, and agency representatives.

- The draft 8000 series publication includes a decision support framework for landowners and resource managers to be able to guide when and where to provide oak restoration activities.
- On-line resources to improve mapping skills for agency representatives and land managers.
http://igis.ucanr.edu/Resources/Oak_Symposium/

Extension activities

Field tours

- May 2014 field tour for the California Board of Forestry members and interested agency members to review policy options and opportunities for oak woodland restoration.
- November 2015 Oak Symposium included two field trips where the California Board of Forestry members, interested agency members, legislative staff and the interested public continued to review policy options and opportunities for oak woodland restoration.
- Several public field tours were given: two tours included field trips to the Bald Hills of Redwood National Park (70 attendees total); another tour included the restoration work and fire effects at the Weaverville Community Forest (40 attendees); and final event is planned for May 2016 to explore restoration strategies.

Organized conferences

- The UCANR 7th California Oak Symposium: Managing Oak Woodlands in a Dynamic World, which occurred on November 3-6, 2014, had a special session on oak conservation and included 4 talks on the conifer encroachment issue in white and black oak woodlands (see session 8 papers). The audience included scientists, landowners, managers, NGOs, and agency representatives.
http://www.fs.fed.us/psw/publications/documents/psw_gtr251/
- The UCCE-led team hosted a major conference that brought together those who work on California black oak and Oregon white oak conservation, management and research from throughout the range of the species (Washington, Oregon and California). Over 200 landowners, agencies representatives, and other interested parties heard a day of talks and attended field trips. All presentations and audio recordings are available at
http://ucanr.edu/sites/oak_range/Conifer_Encroachment/California_Black_Oak_and_Oregon_White_Oak_Woodland_Ecology_and_Management_Symposium/

Conference presentations

- Schriver M. 2015. Establishment and growth patterns of Oregon white oak and California black oak woodlands in Northwestern California. California State University Student Research Competition. San Bernardino, California. (Oral Presentation) * *She won 2nd place in her competition division.*
- Four oral presentations at the 2014 Oak Symposium in Visalia.
http://www.fs.fed.us/psw/publications/documents/psw_gtr251/ See papers in Section 8 numbered 505, 515, 521, 529 at
- Three presentations were given at two regional seminars hosted by Cooperative Extension in Eureka in 2014 (100 people in attendance) and 2015 (65 people in attendance) that showcased this project and emerging results.

Poster presentations

- Information from this project was presented in poster form at the Eureka 2015 Oak Symposium and the 2015 ANR Initiatives Conference. Reference: Tools for a changing landscape: Understanding disturbance and vegetation dynamics in Northern California oak woodlands. Y. Valachovic, L. Quinn-Davidson, R. Standiford, M. Kelly, M. Potts, R. Sherriff, M. Schriver, K. McGown, M. Eitzel, M. Varner, C. Lee, G. Giusti. Poster published in the October 2015 ANR Initiatives Conference at <http://ucanr.edu/sites/2015jointsiconference/files/221590.pdf>
- Additionally the HSU graduate student presented a poster at the HSU IdeaFest. Reference: Schriver M., R. Sherriff. 2015. Establishment patterns of Oregon white oak and California black oak woodlands in Northwestern California. Humboldt State University IdeaFest. Arcata, California.

PROJECT OUTCOMES

The loss of oak woodlands to native conifer encroachment is a major conservation concern in California, resulting in associated losses of wildlife habitat, traditional uses, biodiversity, and other ecosystem services. These concerns have drawn increasing attention in recent years, and oak woodland conservation and restoration efforts have gained momentum; the California Board of Forestry and Fire Protection and the State Legislature are developing policy changes as a result of this project, and agency cost-share and incentive programs are rapidly expanding. In 2012, the ANR Competitive Grants Program funded a research project to better characterize the rate and extent of encroachment, and to develop decision support tools for landowners and land managers. This project demonstrated clear patterns of encroachment-associated impacts throughout the North Coast, including widespread losses of oak woodlands and the ecosystem services that they provide. The findings and the goals of this project tie specifically to the Sustainable Natural Ecosystems ANR Strategic Initiatives:

- (i) Balancing multiple ecosystem services and biotic diversity in California's working landscapes
- (ii) Tools for land change science

Changes in Learning

This funding provided essential baseline information to help landowners understand benefits of and threats to oak woodlands and to develop oak conservation strategies. The findings documented important age and stand structure data that are also helping regulatory agencies support new oak conservation efforts. The data sets created through this project have been queried multiple times to answer questions from the policy efforts. Examples of the questions that have been answered include: *What is typical basal area of an oak stand? How does encroachment relate to stand site indexes? How*

old are oaks versus conifers (which are often much larger and younger than the oaks)? What is the frequency of listed plant species found in these stands? How would an age limit on the harvest of conifers affect seed source availability? Having this readily available dataset has enabled the team to answer critical questions of interest from a range of policy makers and public interest groups and to help craft effect policies. The team has also provided countless hours of one-on-one policy consultations during the first quarter of 2016.

We have observed a significant increase in call volumes and interests in the oak woodland issues as a result of this project. The policy changes and subsequent funding brought by this ANR grant are a further illustration of the awareness that this project has stimulated.

Encouraged collaboration:

This funding helped develop collaborative efforts with:

- The California Board of Forestry and Fire Protection, which has drafted a new permit option—a Special Prescription—for landowners to be able to manage their woodlands. The anticipated approval date is June 2016. This new permit will give landowners a pathway to harvest encroaching conifers and commercialize merchantable trees, which is illegal under current law. This permit will be most appropriate for landowners in the later and more advanced stages of encroachment, where the conifer trees have the most merchantable value.
- Assesmblymember Jim Wood, who has introduced a new permit option—an oak woodland exemption—for landowners to be able to manage their woodlands. The exemption is currently in the legislative review process and will hopefully be approved in the summer of 2016. The exemption is important because it clarifies that this type of conifer removal does not constitute a “conversion,” and it creates a ministerial permit for landowners to be able to remove smaller conifers from their oak woodlands.
- The Natural Resources Conservation Service (NRCS), which has committed significant new funding through their RCPP program to help landowners to manage these encroachment issues, and has granted UC a Conservation Innovation Grant to understand restoration effectiveness. Additionally, both NRCS and the US Fish and Wildlife Service now look to UCCE for technical guidance.
- Multiple NGOs (e.g., North Coast Regional Land Trust, Buckeye Conservancy, The Nature Conservancy, Pacific Forest Trust, Sonoma Land Trust, California Native Plant Society, etc.), who have all identified that these oak ecosystems are biologically important and that this project’s data provide evidence for the development of conservation strategies (and new policies) to help private and public land managers steward their oak woodlands.

Strengthened the research-extension network:

This proposal idea was developed by the Cooperative Extension Humboldt County team and the funding helped develop an integrated team of UC faculty, specialists, advisors, staff research associates, and graduate students. Additionally, the funding helped support collaboration with the California State University System. As a result of this funding, the information was extended through workshops, field tours, and conferences for landowners, regulatory agencies, policy makers, NGOs, and other interested groups.

Additional resources leveraged:

- A UCCE-Humboldt-led partnership developed, submitted, and successfully secured \$2.68 million from NRCS's Resource Conservation Partnership Program (RCPP). These funds, which should be made available to landowners starting summer 2016, will support oak-focused restoration and conservation activities on private lands throughout Humboldt, Mendocino, and Trinity counties.
- In the fall of 2015, UCCE received \$75,000 from NRCS's California Conservation Innovation Grants program to conduct a case study evaluation of the effects of oak restoration techniques. The UCCE team will select sites that have had 5+ years post-restoration response. Field work will begin May 2016.

Graduate students

Two UC Berkeley graduate students and one Humboldt State graduate student worked on this project.

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UC DELIVERS

Headline/Title: UC spurs momentum around oak woodland conservation

The Issue

The loss of oak woodlands to native conifer encroachment is a major conservation concern in California, resulting in associated losses of wildlife habitat, traditional uses, biodiversity, and other ecosystem services. These concerns – compounded by development pressures, evolving understanding of fire’s role in California landscapes, and health threats like sudden oak death – have drawn increasing attention in recent years, and oak woodland conservation and restoration efforts have gained momentum. California counties have recently developed oak woodland conservation plans, and agencies are distributing funds for cost-share and incentive programs aimed at conserving and restoring these important ecosystems. However, efforts are complicated by a paucity of information on the rate and extent of conifer encroachment in oak woodlands, the history and successional dynamics of affected woodlands, and trajectories of oak regeneration and conifer recruitment in a changing climate—information that is critical for conservation and restoration plans to both take shape and endure.

Landowner, policy makers, conservation groups and agencies have looked to UCCE for scientific guidance and landowner cooperation. This project addressed research and extension needs, supplying scientific tools to guide conservation and restoration planning and the extension setting necessary to make those tools available and effective.

What has ANR done?

UC funded an interdisciplinary research team of UC and California State University scientists to address fundamental gaps in knowledge about California black oak and Oregon white oak woodland ecology in the north coast. The team brought in collaborators from several agencies and has channeled the support of private and public landowners in the region. Research findings have contributed directly to policy development and new funding opportunities that support oak woodland restoration and conservation throughout the region.

In many ways, the loss of oak woodlands is the quintessential UC Cooperative Extension issue: the loss threatens some of the most productive working landscapes in our region, affecting both ecological and cultural resources; it necessarily involves private landowners, who own and manage a majority of affected woodlands but naturally fall outside the scope of the land management agencies working on the issue; and it requires collaboration between academic experts and people on the ground.

What is the payoff?

The project provided the following deliverables:

- The first multi-county, multi-landowner characterization of oak woodland stand structure and conifer encroachment for deciduous oak woodlands in northern California;
- Models of conifer time to dominance, which are useful in the development of restoration and conservation priorities and guidelines;
- Communication of results to land management agencies, counties, private landowners, and other stakeholders;
- Science-based outreach materials to inform the restoration programs of the USDA Natural Resources Conservation Service, US Fish and Wildlife Service and CAL FIRE (e.g., EQIP, Partners, CFIP)

- A multi-state [symposium](#) on oak woodland conservation and management issues that attracted 200 attendees from across the Pacific Northwest;
- An ANR [website](#) that describes the oak woodland encroachment issues. The website includes a [story map](#), presentations and audio clips of a conference focused on this topic, peer-reviewed papers, and extension publications.
- A variety of peer-reviewed papers. The papers address:
 - Stand and age structures in North Coast oak woodlands (two papers in development and one master's [thesis](#) published)
 - A published [paper](#) that provides an understanding of challenges and opportunities in synthesizing historical geospatial data using statistical models.
 - Plant biodiversity changes following encroachment (one paper accepted for publication and one in development).
- Essential seed funding to support further oak woodland conservation and research, including \$2.68 million from NRCS's Regional Conservation Partnership Program to support restoration and conservation activities on private lands in northwestern California, and an additional \$75,000 to this UC team to evaluate the effectiveness of previously implemented oak woodland restoration strategies using a case study approach.
- A published [policy analysis](#) shared with California Board of Forestry and Fire Protection and the State Assembly that is supporting two pending policy changes: a new Timber Harvest Plan option known as a "special prescription" developed by the California Board of Forestry and a new permit for landowners being developed through AB 1958.

Clientele Testimony

From Mike Miles, California Board of Forestry/Humboldt Redwoods Company: "Information collected and distributed through UCCE has played a critical role in forest policy and regulation affecting the future of California's oak woodlands. I have seen the value and appreciation of the UC's involvement in oak woodland research and education play out in an array of different scenarios, ranging from public and landowner education at the local level to Board of Forestry and Legislative deliberation in the state's capitol."

Dina Moore, Rancher: "On our ranch we have observed a steady march of conifers into our native oak rangeland at an alarming rate. The science and research that the UCCE has led has provided a platform for informed decisions at a policy level. Having participated in several field trips and a symposium hosted by UCCE the conversations and ideas that have been generated, I believe will lead to oak woodland restoration practices that will benefit the ecosystems and landscapes that are represented by our native oaks."

Photo

Douglas-fir getting a stronghold in north coast oak woodlands. Photo Credit: Yana Valachovic

