



Thermal Cauterization of Pruning Cuts and Tree Wounds: Traditional Stewardship in Modern Arboriculture on Fire-Adapted Oaks

By Sprout Weinberger and Siena King

Elemental Tree Network LLC

September 2026

Abstract

This research explores the application of fire as a tree care technique and its potential effects on the Compartmentalization of Decay/Damage in Trees (CODIT) within fire-adapted *Quercus agrifolia* and *Quercus wislizeni*. Indigenous cultures worldwide have used fire as a tool for forest and tree management for millennia. This study draws from these ancient practices through the controlled application of fire using a handheld blowtorch to cauterize pruning cuts and tree wounds.

Thermal cauterization has demonstrated observable benefits, including improved wound closure, and accelerated woundwood development at the branch collar, reducing the time that tree tissue is exposed to microorganism colonization in ecosystems with high populations of pathogens. By blackening, but not charring, key tissue layers on the wound surface, thermal treatment on pruning cuts appeared to cause accelerated occlusion when compared with untreated controls. Cauterized wounds exhibited significant woundwood formation, depending on wound size and tree vitality. In contrast, untreated wounds exhibited minimal callus growth and a higher susceptibility to colonization by fungi.

These findings position thermal cauterization as a sustainable, chemical-free experimental technique for managing tree wounds, particularly in fire-adapted ecosystems. By integrating prescribed fire techniques into modern arboricultural research; this approach offers an opportunity to investigate a technique that may assist in supporting wound closure, enhancing overall tree health, and reinforcing the ecological resilience of fire-prone forests.

Introduction

Trees are routinely injured by pruning, storms, construction, vehicles, animals, and human disturbances. Once living tissue is exposed, it responds to injury through internal compartmentalization and the subsequent production of new tissue around the exposed surface (Shigo and Marx 1977; Shigo 1984;

Morris et al. 2016). Compartmentalization limits the spread of discoloration and decay within existing wood, while woundwood is the outward process by which subsequent growth progressively covers the wound surface (Shigo 1984). Recent work has further clarified the terminology used to describe these processes: woundwood is lignified callus tissue, while vessel occlusion refers to the internal plugging of conducting tissues by structures such as tyloses and gums and represents a separate process from wound occlusion (De Micco et al. 2016).

The capacity to compartmentalize or seal injury is a fundamental component of woody plant defense. Shigo and Marx (1977) described this response through the Compartmentalization of Decay/Damage in Trees (CODIT) model, demonstrating that trees establish boundaries that restrict the spread of microorganisms and associated discoloration following injury. These boundaries result from both preexisting anatomical features and active biological responses involving living cells within the tree (Shigo and Marx 1977; Shigo 1984; Morris et al. 2016). The extent and effectiveness of these responses vary with species, tree condition, wound characteristics, season, and environmental conditions (Shigo 1984; Morris et al. 2016). Wound development and internal compartmentalization are therefore influenced by both the biology of the individual tree and the conditions under which the injury occurs.

Prior to the introduction of the CODIT model there was concern in the arboricultural industry about the vulnerability of exposed wood, which led to widespread use of wound dressings, paints, chemicals, petroleum and other materials throughout the mid to late twentieth century. These treatments were intended to protect exposed surfaces and reduce the entry of microorganisms into pruning wounds and other injuries (Shigo and Shortle 1983; Shigo 1984). However, experimental work by Shigo and Shortle (1983), found that none of the thirteen wound dressings examined improved compartmentalization. Their findings contributed to the abandonment of routine wound painting and sealing in modern arboricultural practice and shifted emphasis toward appropriate pruning cuts and the tree's natural response to injury (Shigo and Shortle 1983; Shigo 1984).

The abandonment of artificial wound dressings did not eliminate questions about the biological significance of conditions at the wound surface. Recent research has demonstrated that modifying the environment of an injured surface can influence subsequent wound development. Lund et al. (2026), compared naturally occurring stem injuries on 112 urban trees in Malmö, Sweden, where some wounds were wrapped with dark plastic and others were left untreated. Linden and maple trees showed greater occlusion when wrapped, whereas birch did not, indicating that the response to wound treatment may vary among taxa (Lund et al. 2026). Together with earlier investigations of wound protection and environmental modification, these findings indicate that conditions at an exposed surface can influence callus formation and subsequent occlusion (Lund et al. 2026; Shigo and Shortle 1983).

This raises a broader question for arboriculture: if the environment surrounding an injury can influence the production of new tissue, what other physical conditions or treatments may affect the subsequent wound response?

Fire provides one such condition. Across many ecosystems, Indigenous peoples have intentionally applied fire as part of systems of stewardship involving vegetation management, habitat creation, food production, regeneration, and the maintenance of ecological relationships (Anderson 2005; Kimmerer 2013; Lake et al. 2017; Klinger 2024). The ecological effects of fire depend on its intensity, duration,

timing, frequency, season, scale, and the biological characteristics of the organisms and environments exposed to it (Stephens and Finney 2002; Pausas et al. 2017). Indigenous and traditional fire practices demonstrate that fire is not simply an intermediate disturbance but a process that improves the overall health and diversity of an ecosystem when applied with intention in appropriate conditions (Anderson 2005; Lake et al. 2017; Adams 2024).

Recent dendrochronological research provides further evidence that Indigenous fire stewardship has actively shaped ecological conditions and fire regimes. Roos et al. (2025) examined tree-ring fire histories across Western Apache (Ndee) territory in Arizona and identified patterns of frequent, small-scale spring fires that could not be explained by climate and lightning alone. The frequency, and spatial distribution of these fires corresponded with periods of Springtime Ndee cultural burning, demonstrating that repeated human application of fire contributed to a distinct and heterogeneous fire regime in landscapes (Roos et al. 2025). Similar research throughout California has documented the role of Indigenous stewardship in shaping oak landscapes through the intentional use of fire and other practices of ecological management (Anderson 2005; Lake et al. 2017; Goode et al. 2022). Indigenous Fire Stewardship can provide a framework for ecological restoration and the revitalization of disrupted fire-adapted systems, supporting continued investigation into how place-based stewardship knowledge can inform contemporary ecological research (Long et al., 2025).

A significant influence on the development of the present study was the research and field practice of Dr. Lee Klinger. Klinger's work examines relationships between fire, Indigenous ecological knowledge, tree tending, and forest structure, including evidence of intensive traditional management within California's oak and redwood ecosystems (Klinger 2006, 2024). His work provides an important connection between the broader ecological history of fire and the practice of examining localized thermal treatment at the scale of an individual tree. Field observations, mentorship and cauterization methods associated with Klinger's work guided the development of the research question investigated in the present study.

California's native oaks provide a particularly relevant context for examining this question. Coast Live Oak (*Quercus agrifolia*) and Interior Live Oak (*Quercus wislizeni*) occur within ecosystems influenced by recurrent fire over long periods of ecological history (Moritz and Odion 2006; University of California Agriculture and Natural Resources 2024). These landscapes were shaped not only by climatic and ecological processes but also by generations of Indigenous stewardship and intentional burning (Anderson 2005; Goode et al. 2022; Lake et al. 2017; Klinger 2024).

More broadly, recurrent fire has acted as an evolutionary force in many plant communities. Woody species occurring in fire-influenced environments have been found to possess specialized traits associated with survival and regeneration following injury (Keeley and Pausas 2022). Fire adapted characteristics in trees can include protective thick bark, strong reaction wood and response growth production, protected meristematic tissues, epicormic or basal resprouting, leaf retention and reduced flammability and slow growth rates (Varner et al. 2016). Research on tree injury from prescribed and wildland fire has also demonstrated that biological outcomes are influenced by the location, duration, and severity of thermal exposure (Stephens and Finney 2002).

The practice examined in this study is thermal cauterization: the controlled application of fire to damaged or wounded tree tissue. Historical applications of cauterization and controlled heat have been examined in

plant disease-management research, including investigations involving *Pseudomonas syringae* cankers (Hawkins 1976). Thermal exposure therefore has precedent as a subject of plant health research, although the application of localized cauterization to pruning wounds has received little attention in contemporary arboricultural literature.

In this study, a handheld MAP-Pro blowtorch was used to apply localized fire to the exposed surfaces of pruning wounds and mechanical damage. The treatment was intended to produce surface blackening without prolonged combustion or extensive charring of the treated tissues. This approach was informed by field work by Dr. Lee Klinger, historical applications of thermal treatment in plant disease management (Hawkins 1976), established principles of tree response to injury and compartmentalization (Shigo 1984), and observations of fire stewardship by people in California oak ecosystems (Goode et al. 2022).

The hypothesis was that controlled thermal exposure could alter the biological conditions present at an injured surface and influence subsequent wound development. This possibility is consistent with evidence that conditions at the wound surface can affect subsequent occlusion (Lund et al. 2026), with established evidence that thermal injury can produce different biological outcomes according to the characteristics of exposure (Stephens and Finney 2002), and with broader research demonstrating the diverse responses of plants to recurrent fire and thermal disturbance (Keeley and Pausas 2022).

The observations described in this study examine whether controlled thermal cauterization is associated with increased woundwood production and accelerated wound occlusion. This preliminary field investigation evaluates a technique that has received little attention within the arboricultural field. The broader question is equally straightforward: if fire has long been understood as a process capable of producing different biological outcomes depending on the characteristics of its application, should localized thermal treatment of tree wounds be investigated more closely?

This research considers whether targeted thermal cauterization may offer an additional approach to supporting wound response in contemporary arboriculture. The objective is to document the observations, examine them within the existing literature on tree injury and fire, and identify the questions that warrant further investigation.

Methods

Study Design

This observational field study was conducted from 2021 through 2026 on approximately 200 native California oaks across 10 properties in coastal California, Santa Cruz County. The study focused primarily on Coast Live Oak (*Quercus agrifolia*) and Interior Live Oak (*Quercus wislizeni*), species occurring within California ecosystems influenced by recurrent fire (University of California Agriculture and Natural Resources 2024).

The study was conducted under operational arboricultural conditions and was designed to document wound response following controlled thermal cauterization. Observations focused on woundwood production, progressive wound occlusion, visible fungal colonization, indicators of insect activity, and

overall tree response. Treated wounds were compared with untreated wounds observed under the same or similar site conditions.

Materials and Equipment

Thermal treatments were performed using a Bernzomatic MAP-Pro handheld blowtorch. Pruning was conducted using a Silky hand saw or chainsaw, depending on branch size and pruning requirements. A plastic scrub brush was used to clean wound surfaces when necessary before or during treatment.

Appropriate personal protective equipment was used during all treatment operations. Fire safety equipment included a fire extinguisher, hose, and portable water pump sprayer.

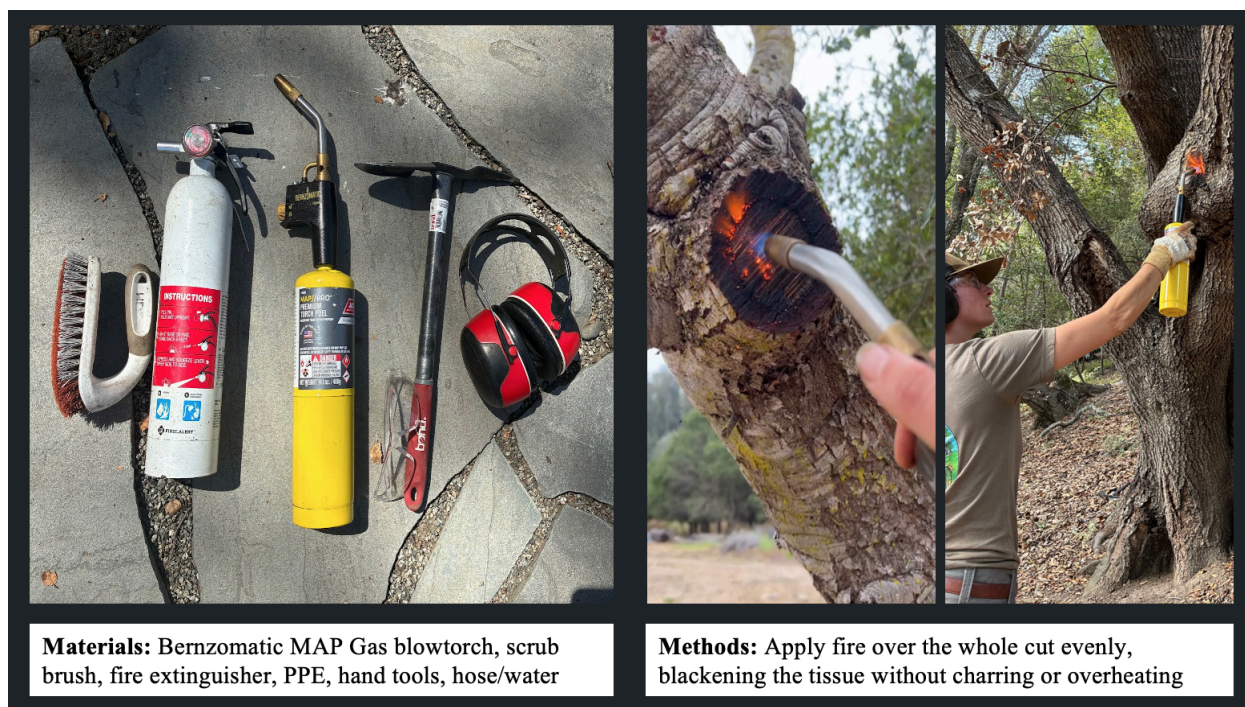


Fig 1. Materials and methods used for thermal cauterization of pruning wounds. (Left) Tools and equipment used to prepare and perform the procedure, including a handheld torch, hand tools, personal protective equipment, and a water supply for fire safety. (Right) Application of controlled flame to the pruning wound, with heat applied directly to the exposed wound surface for a controlled duration sufficient to blacken the tissue without extensive charring.

Treatment Application

Fire treatment was applied to fresh pruning cuts, older pruning cuts, mechanical injuries, decay margins, and localized areas exhibiting visible signs of pathogen activity. Treatments were performed immediately following pruning operations or during corrective tree health interventions.

A handheld blowtorch was used to apply fire across the exposed surface of the wound and, where appropriate, the surrounding wound margins. Treatment duration ranged from approximately 10 to 90

Cauterizing Pruning Cuts & Tree Wounds

seconds or more, and was adjusted according to wound size, bark thickness, moisture content, and tissue condition.

The intended treatment endpoint was uniform surface blackening without prolonged combustion or extensive charring. Application distance and duration were adjusted as necessary to achieve this condition across wounds of different sizes and characteristics. Particular attention was given to the wound margins and the face of the pruning cut or wound while avoiding unnecessary heating of adjacent living tissues on the branch collar. Larger wounds generally required longer exposure to achieve consistent surface blackening.

The treatment approach was informed by cauterization experiments and field observations conducted by Klinger along the central California coast (Klinger 2024) and applications of thermal treatment in plant disease management (Hawkins 1976).

No wound paints, petroleum-based sealants, fungicides, or synthetic wound dressings were applied to treated wounds or controls during the study period.

Primary Study Site

The primary study site was a young oak woodland in Watsonville, California, consisting of approximately 50 study trees generally less than 50 years old. The trees were growing in close proximity in clay loam soil, and overall vigor was low to moderate at the beginning of the study.

Severely declining trees were selectively removed to reduce crowding and improve growing conditions for the remaining trees. Following these improvements, lower branches were pruned from the remaining study population. The resulting pruning wounds became the primary treatment population for the study.

Selected wounds were thermally cauterized following pruning, while untreated pruning wounds were retained as observational controls. Treated and untreated wounds were subsequently monitored over time under the same general site conditions.

Control Comparisons

Untreated wounds served as observational controls throughout the study. Whenever possible, treated wounds were compared directly with untreated wounds on the same tree. Where same-tree comparisons were unavailable, untreated wounds were selected from nearby trees growing under similar environmental and soil conditions.

Control wounds received no thermal treatment and were monitored concurrently with treated wounds. Comparisons focused on the progression of woundwood development and wound occlusion over successive monitoring periods.

Monitoring and Evaluation

Trees were monitored at intervals of approximately three to six months through field observation and photographic documentation. Wound response was evaluated through repeated visual assessment and comparison of sequential photographs. Where sufficient woundwood was present, a digital caliper was used to document changes in wound development over time.

Site Conditions

Tree condition and site quality varied among the 10 study properties. These differences were considered during field observations and interpretation of individual wound responses. The primary study site provided the largest concentration of treated and untreated pruning wounds observed under shared environmental conditions.

Study Limitations

Because the study was conducted under operational arboricultural conditions, variables including wound size, tree age, species, site quality, soil conditions, environmental exposure, and previous management history could not be fully standardized. Treatment duration also varied according to the physical characteristics and condition of individual wounds.

The study did not include laboratory identification of fungal or microbial organisms, quantitative measurements of insect populations, histological examination of treated tissues, or direct measurements of treatment temperature. The observational design therefore does not establish the biological mechanism responsible for the responses documented during the study.

Results

Wound Response and Occlusion

Across the 200 oaks included in the testing group, thermally cauterized pruning wounds generally demonstrated faster woundwood development and more progressive occlusion than untreated comparisons. Woundwood developed from the margins of treated pruning cuts and progressed inward across the exposed wound surface. The extent and rate of occlusion varied among individual wounds. Smaller wounds on vigorous trees growing under favorable conditions were more likely to achieve substantial or complete occlusion, whereas larger wounds generally remained partially exposed while continuing to produce woundwood at the margins.

Untreated comparison wounds also showed variable responses. Some wounds on vigorous trees produced woundwood, particularly under favorable growing conditions; however, untreated wounds generally demonstrated less extensive wound-margin development and less progression toward occlusion than treated wounds.

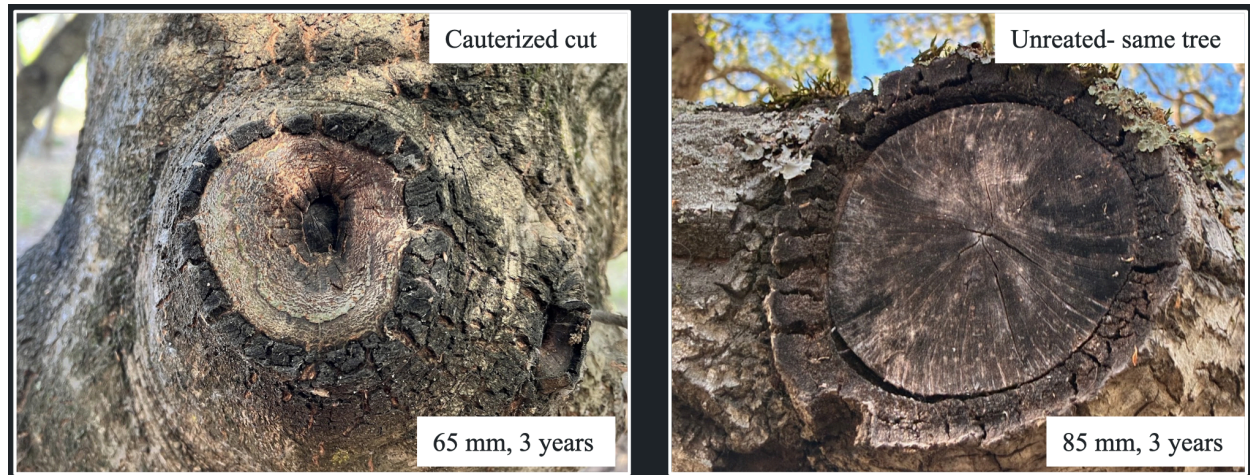


Fig 2. Comparison of pruning-wound responses three years after treatment. (Left) 66 mm thermally cauterized pruning wound showing visible woundwood production and progression of wound occlusion. (Right) 85 mm Untreated pruning wound showing no observable callus or woundwood growth and no measurable wound occlusion at the time of observation.

Wound Response at Different Observation Intervals

Photographic observations included thermally cauterized pruning wounds examined from approximately six months to five years after treatment. The images present representative examples of wounds at different stages of development and are intended to illustrate the range of responses observed during the study rather than a standardized progression among individual wounds.

Wounds observed during earlier intervals, including approximately six months to two years after treatment, commonly showed visible woundwood development around the wound margins.

Cauterizing Pruning Cuts & Tree Wounds



Fig 3. Multiple thermally cauterized pruning wounds on Coast Live Oak (*Quercus agrifolia*) 1–2 years after treatment. All wounds shown exhibited visible woundwood production and progressive wound occlusion during the observation period.

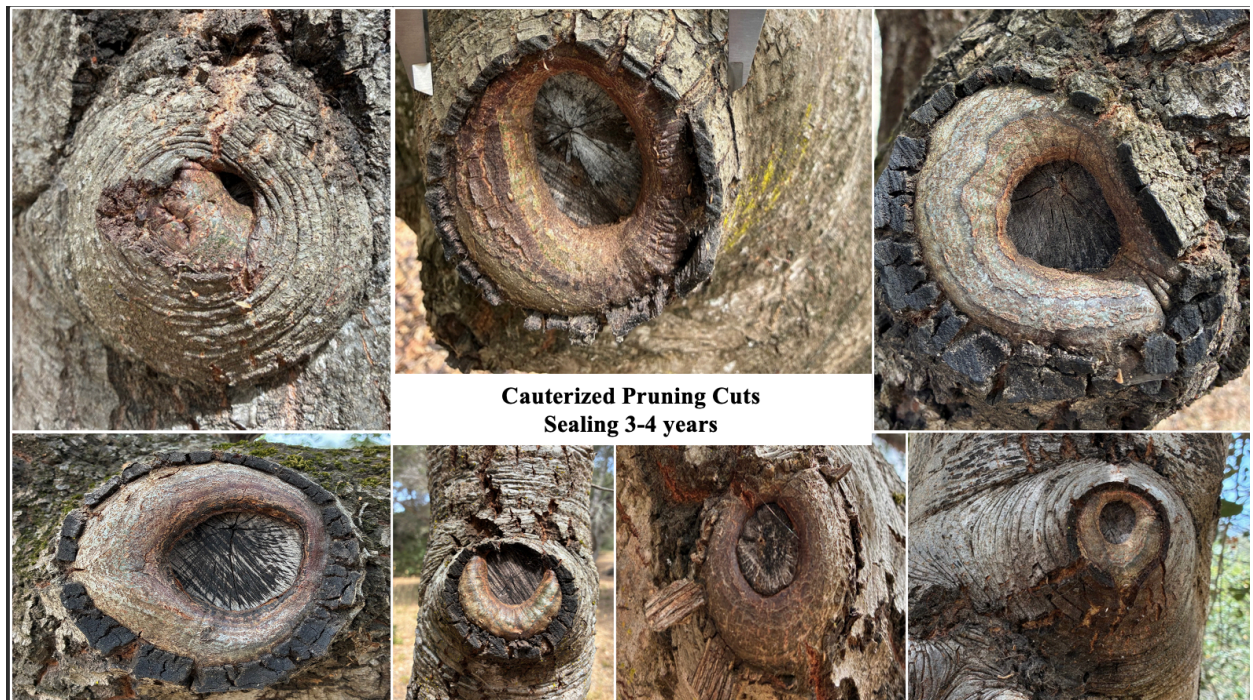


Fig 4. Multiple thermally cauterized pruning wounds on Coast Live Oak (*Quercus agrifolia*) three to four years after treatment. All pruning wounds shown exhibited strong woundwood production and advanced progression of wound occlusion.

Untreated Comparison Wounds

Untreated pruning wounds were documented throughout the study as observational comparisons. Although some untreated wounds produced visible woundwood, particularly on vigorous trees, their response was generally less extensive than that observed among thermally cauterized wounds. Direct comparisons were particularly informative where treated and untreated wounds occurred on the same tree.

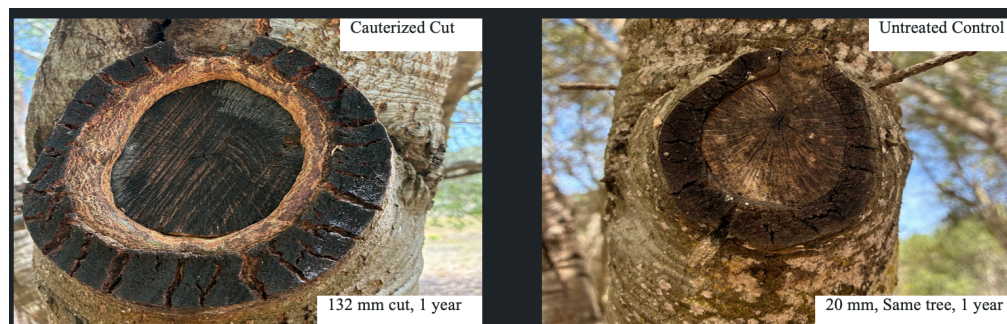


Fig 5. In a one-year comparison, a 132-mm thermally cauterized pruning cut demonstrated substantial woundwood development, while a 20-mm untreated pruning cut on the same tree showed no observable woundwood. Because the cuts differed in size and other individual characteristics, this comparison is presented as a representative observation rather than an isolated quantitative measure of treatment effect.



Fig 6. Comparison of pruning-wound responses two years after treatment on the same tree. Left: Thermally cauterized pruning wound showing strong wound-wood development and substantial wound occlusion. Right: Untreated pruning wound showing minimal woundwood, visible staining and discoloration present at the center of the exposed wound.

Cauterizing Pruning Cuts & Tree Wounds



Fig 7. Comparison of pruning-wound responses in Coast Live Oak (*Quercus agrifolia*) four years after treatment. (Left) Thermally cauterized pruning wound showing substantial wound occlusion. (Right) Untreated pruning wound showing extremely minimal woundwood production and discoloration.



Fig 8. Comparison of wound response showing a 112 mm pruning cut with visible wound-wood development and a 62 mm pruning cut with no visible wound response on the same tree.

Overall, untreated wounds more frequently remained exposed and showed less progressive woundwood development during the observation periods represented in the photographic record.

Sequential Occlusion of Individual Wounds

Sequential photography of selected pruning wounds documented changes in individual wounds over successive monitoring periods. These images provided direct visual evidence of continued woundwood development and progressive reduction of the exposed wound surface.

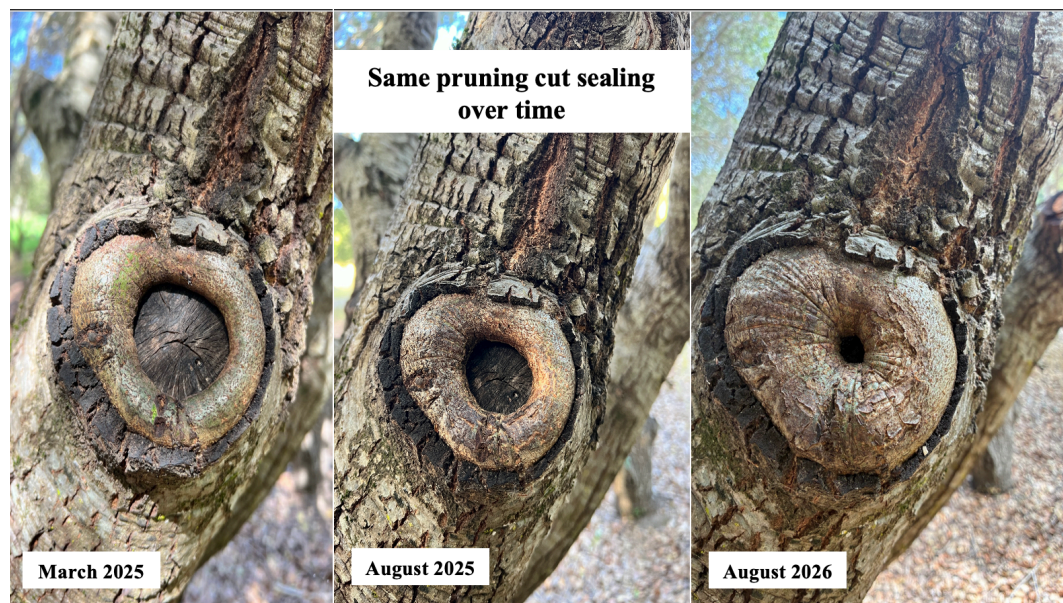


Figure 9. Progressive occlusion of the same 94-mm thermally cauterized pruning wound from spring 2025 through summer 2026. Sequential photographs document continued woundwood development from the wound margins and progressive reduction of the exposed wound opening over the observation period.

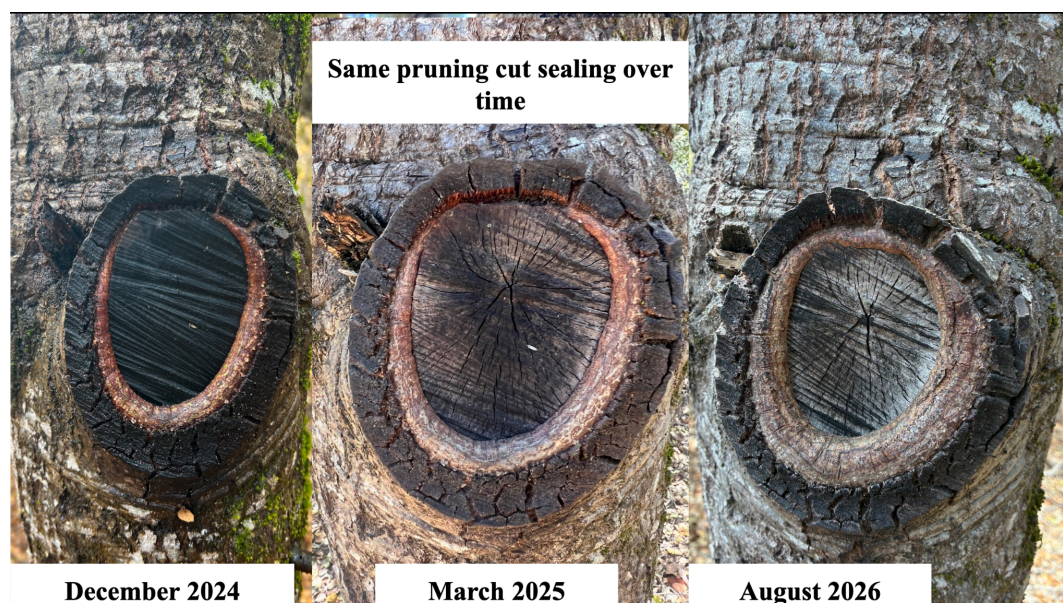


Figure 10. Progression of wound occlusion in a 111 mm pruning cut documented in December 2024, March 2025, and August 2026. Woundwood is visibly advancing across the wound surface over time.

Wound Condition and Visible Biological Activity

Visible indicators of fungal growth were more frequently observed on untreated wounds, particularly on older wounds and those occurring under shaded or moisture-retentive conditions. Treated wounds generally remained stable during subsequent monitoring and showed fewer visible indicators of surface fungal colonization.

Indicators of insect activity, including frass, boring damage, and galleries, were also recorded during field inspection. Treated wounds generally showed fewer visible indicators of continued insect activity during subsequent monitoring.



Figure 11. Comparison of an untreated pruning wound showing visible fungal intrusion and a thermally cauterized treated area of mechanical damage.



Figure 12. Untreated pruning wound showing visible saprotrophic fungus *Stereum ostrea* before treatment (left) and the same wound following cleaning and thermal cauterization (right).

Summary of Observed Treatment Response

The primary pattern observed during the five-year observation period was greater woundwood development and more progressive wound occlusion among thermally cauterized pruning wounds than among untreated observational comparisons. The magnitude and rate of response varied among individual wounds and were influenced by wound size, tree vitality, and site condition.

Summary of observational findings following thermal cauterization		
	Column 1	Column 2
Observation	Thermally treated wounds	Untreated comparison wounds
Wound-wood development	Repeatedly observed; often substantial	Present in some wounds, generally less extensive
Progressive wound occlusion	Repeatedly observed	Generally slower or limited
Response at wound margins	Frequently pronounced	Generally less pronounced
Complete or near-complete occlusion	Observed, particularly on smaller wounds and vigorous trees	Less frequently observed
Visible fungal colonization	Less frequently observed during monitoring	More frequently observed
Visible insect activity	Fewer visible indicators during monitoring	More frequently observed
Influence of tree vitality	Greater response on more vigorous trees	Greater response also observed on more vigorous trees
Influence of wound size	Smaller wounds generally progressed more rapidly	Larger wounds generally remained exposed

Fig 10. Findings summarize repeated field and photographic observations. Wound response varied with tree vitality, wound characteristics, and site conditions. Observations of fungal colonization and insect activity were based on visible field indicators and were not confirmed through laboratory identification.

Discussion

Overview of Findings

The most pronounced response was the development of woundwood around the margins of treated wounds. Smaller wounds on vigorous trees were more likely to progress toward complete occlusion, while larger wounds often remained partially exposed but continued to produce wound wood during subsequent monitoring. Untreated wounds were also capable of producing callus and wound wood, particularly on vigorous trees, but generally did not demonstrate the same extent of development or progression toward occlusion observed in treated comparisons.

Visible fungal colonization and indicators of insect activity were more frequently documented on untreated wounds and previously damaged tissues, whereas treated wounds generally remained visually stable during subsequent monitoring. Because fungal and insect species were not analyzed and internal wood condition was not evaluated, these observations are limited to visible differences in wound condition.

The results identify a consistent association between controlled thermal cauterization and increased woundwood development represented in this study. The observations do not establish a causal mechanism, but they provide a basis for interpreting the treatment response within existing research on tree injury and for defining the next stages of investigation.

Interpretation of Treatment Response

The variation observed among individual wounds was expected because tree wound response is influenced by species, vitality, wound characteristics, and growing conditions (Luley, 2016; Lund et al., 2026). Untreated wounds on vigorous trees were also capable of producing callus and woundwood, but their response was generally less extensive than those treated with fire.

The primary response documented in this study was external wound development. Increased woundwood and progressive occlusion do not, by themselves, demonstrate changes in internal compartmentalization, decay, or vessel occlusion, which would require anatomical or other diagnostic investigation (Shigo & Marx, 1977; Luley, 2016). The mechanism responsible for the increased wound response observed following thermal treatment therefore remains unknown.

Recent research provides additional reason to investigate the wound surface as a biologically active environment. Lund et al. (2026) demonstrated that modifying conditions at an injured surface influenced subsequent occlusion in some tree genera, although the response varied by species. The present study examined a different intervention but similarly suggests that conditions at the wound surface may influence subsequent wound development.

Future Research

Future studies could use standardized wound dimensions, untreated controls, repeated measurements of occlusion, and precise documentation of treatment duration and thermal exposure. Anatomical and histological examination could determine how tissues at the wound margin respond to controlled heating, while chemical and physiological research could examine whether thermal exposure affects processes involved in wound response and defense.

Species-specific research will also be essential. The present study focused primarily on *Quercus agrifolia* and *Q. wislizeni*, and the findings should not be generalized to species with substantially different wound responses or relationships with fire. Fire-adaptive traits vary among woody plants, including characteristics associated with protection and recovery following thermal injury (Pausas et al. 2017; Keeley and Pausas, 2022).

Indigenous Science and Arboricultural Research

The development of this research question was informed in part by Indigenous traditional ecological knowledge and the long history of intentional fire stewardship. This focus should remain central to future research, not simply serving only as historical background. Indigenous fire knowledge reflects long-term observation of relationships among the elements, species, season, and place. Indigenous researchers have

emphasized the importance of appropriate governance and Indigenous authority in research involving this knowledge (Adams, 2024; Lake et al., 2017).

Indigenous science should therefore be recognized as an active source of inquiry in the development of new approaches to arboriculture (Long et al., 2025). As this research expands, collaboration involving Indigenous knowledge should maintain appropriate relationships, context, and respect for Indigenous sovereignty rather than separating practices from the knowledge systems in which they developed (Adams, 2024).

Broader Implications

This study provides an initial observational record of a consistent difference in wound response following controlled thermal cauterization. The results do not support universal application, but they provide sufficient evidence to justify more rigorous investigation in fire adapted tree species. By combining controlled experimentation with continued field observation, future work can determine whether thermal cauterization has a practical role in the care of specific trees and species. More broadly, the findings support continued investigation of ideas that extend beyond conventional approaches to tree injury.

Conclusion

Over the duration of the five year study, thermally cauterized wounds consistently produced greater woundwood development and more progressive wound occlusion than untreated comparison wounds. Although the magnitude of the response varied with tree condition, wound characteristics, and site conditions, the overall pattern remained consistent under operational arboricultural conditions.

These findings support further investigation of controlled thermal cauterization as a potential arboricultural wound treatment for fire-adapted tree species. Future research can investigate the biological mechanisms responsible for the observed response and further clarify the applications for which thermal cauterization may be most effective. The observations presented here provide a foundation for further research and for evaluating whether controlled thermal treatment can expand the tools available to support the long-term preservation of trees of exceptional age, value, cultural significance and ecological importance.

Acknowledgments

We gratefully acknowledge the teachers and practitioners whose expertise and guidance helped shape the questions explored in this research, particularly Dr. Lee Klinger, Dr. Melinda Adams, and Ron Goode. Their work in fire ecology, stewardship, and investigation of relationships between people, trees, and place provided important context and inspiration for this study.

We'd also like to thank the land holders who permitted access to their trees and properties over the past five years. Special thanks to the primary study site Kindred Herbs Nursery in Watsonville, California. The trust and collaboration has been foundational in the establishment of this research.

Sources

Adams, M. M. (2024). Indigenous fire data sovereignty: Applying Indigenous data sovereignty principles to fire research. *Fire*, 7(7), Article 222. <https://doi.org/10.3390/fire7070222>

Anderson, M. K. (2005). *Tending the wild: Native American knowledge and the management of California's natural resources*. University of California Press.

De Micco, V., Balzano, A., Wheeler, E. A., & Baas, P. (2016). Tyloses and gums: A review of structure, function and occurrence of vessel occlusions. *IAWA Journal*, 37(2), 186–205. <https://doi.org/10.1163/22941932-20160130>

Goode, R. W., Beard, S. F., & Oraftik, C. (2022). Putting fire on the land: The Indigenous people spoke the language of ecology, and understood the connectedness and relationship between land, water, and fire. *Journal of California and Great Basin Anthropology*, 42(1), 85–95.

Hawkins, J. E. (1976). A cauterization method for the control of cankers caused by *Pseudomonas syringae* on limbs of stone fruit trees, using a hand-held propane burner. *Plant Disease Reporter*, 60(1), 60–61.

Keeley, J. E., & Pausas, J. G. (2022). Evolutionary ecology of fire. *Annual Review of Ecology, Evolution, and Systematics*, 53, 203–225. <https://doi.org/10.1146/annurev-ecolsys-102320-095612>

Kimmerer, R. W. (2013). *Braiding sweetgrass: Indigenous wisdom, scientific knowledge, and the teachings of plants*. Milkweed Editions.

Klinger, L. (2006). Ecological evidence of intensive cultivation of oaks by California Indians: Implications for the treatment of sudden oak death. In S. J. Frankel, P. J. Shea, & M. I. Haverty (Tech. coords.), *Proceedings of the sudden oak death second science symposium: The state of our knowledge* (General Technical Report PSW-GTR-196, pp. 487–488). U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station.

Klinger, L. (2024). *Forged by fire: The cultural tending of trees and forests in Big Sur and beyond*. Independent publisher.

Lake, F. K., Wright, V., Morgan, P., McFadzen, M., McWethy, D., & Stevens-Rumann, C. (2017). Returning fire to the land: Celebrating traditional knowledge and fire. *Journal of Forestry*, 115(5), 343–353. <https://doi.org/10.5849/jof.2016-043R2>

Long, J. W., Hankins, D. L., & Adams, M. M. (2025). Indigenous fire stewardship to revitalize disrupted ecosystems. *Global Change Biology*, 31(8), e70411. <https://doi.org/10.1111/gcb.70411>

Luley, C. J. (2016). *Wood decay fungi: Common species on living or recently dead trees in the Northeast and Central United States*. Urban Forestry LLC.

- Lund, A., Wiström, B., Östberg, J., Andersson, A. M., Gredvall, H., & Levinsson, A. (2026). Wound occlusion following stem injuries: A comparative analysis of plastic wrapped and unwrapped trees. *Arboriculture & Urban Forestry*, 52(4), 369–380. <https://doi.org/10.48044/jauf.2026.014>
- Moritz, M. A., & Odion, D. C. (2006). Examining the relationship between fire history and sudden oak death patterns: A case study in Sonoma County. In S. J. Frankel, P. J. Shea, & M. I. Haverty (Tech. coords.), *Proceedings of the sudden oak death second science symposium: The state of our knowledge* (General Technical Report PSW-GTR-196, pp. 169–177). U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station.
- Morris, H., Plavcová, L., Cvecko, P., Fichtler, E., Gillingham, M. A. F., Martínez-Cabrera, H. I., McGlinn, D. J., Wheeler, E. A., Zheng, J., Ziemińska, K., & Jansen, S. (2016). A global analysis of parenchyma tissue fractions in secondary xylem of seed plants. *New Phytologist*, 209(4), 1553–1565. <https://doi.org/10.1111/nph.13737>
- Pausas, J. G., Keeley, J. E., & Schwilk, D. W. (2017). Flammability as an ecological and evolutionary driver. *Journal of Ecology*, 105(2), 289–297. <https://doi.org/10.1111/1365-2745.12691>
- Roos, C. I., Kaib, J. M., Laluk, N. C., Adams, M. M., Guiterman, C. H., Baisan, C. H., Morino, K., & Swetnam, T. W. (2025). Tree rings reveal persistent Western Apache (Ndee) fire stewardship and niche construction in the American Southwest. *Proceedings of the National Academy of Sciences of the United States of America*, 122(32), Article e2509169122. <https://doi.org/10.1073/pnas.2509169122>
- Shigo, A. L. (1984). *Modern arboriculture: A systems approach to the care of trees and their associates*. Shigo and Trees, Associates.
- Shigo, A. L., & Marx, H. G. (1977). *Compartmentalization of decay in trees* (Agriculture Information Bulletin No. 405). U.S. Department of Agriculture, Forest Service.
- Shigo, A. L., & Shortle, W. C. (1983). Wound dressings: Results of studies over 13 years. *Journal of Arboriculture*, 9(12), 317–329. <https://doi.org/10.48044/jauf.1983.074>
- Stephens, S. L., & Finney, M. A. (2002). Prescribed fire mortality of Sierra Nevada mixed conifer tree species: Effects of crown damage and forest floor combustion. *Forest Ecology and Management*, 162(2–3), 261–271. [https://doi.org/10.1016/S0378-1127\(01\)00521-7x](https://doi.org/10.1016/S0378-1127(01)00521-7x)
- University of California Agriculture and Natural Resources. (2024). *The role of fire in California's oak woodlands*.
- Varner, J. M., Kane, J. M., Hiers, J. K., Kreye, J. K., & Veldman, J. W. (2016). Suites of fire-adapted traits of oaks in the southeastern USA: Multiple strategies for persistence. *Fire Ecology*, 12(2), 48–64. <https://doi.org/10.4996/fireecology.1202048>