DRYWOOD TERMITES

Integrated Pest Management In and Around the Home

The western drywood termite, *Incisitermes minor* (Figure 1), is California's second most important termite pest after the subterranean termite and is the most common species of drywood termite. It is a native insect that has been here millions of years, mostly infesting dead wood in trees along rivers, washes, and arroyos. Drywood termites are commonly found along the Pacific coastal region extending into the Central Valley and deserts of Southern California.

Sometimes drywood termites are confused with dampwood termites, *Zootermopsis angusticollis* and *Z. nevadensis* (Figure 2), which are also common in central and northern coastal areas in California. Both drywood and dampwood termites nest in wood, not in soil, and do not require soil contact. However, dampwood termites require wood that is high in moisture content (often in contact with soil as a moisture source) and are most often found in cool, humid areas along the coast or in forests of the Coast Range, the Cascade Range, and the Sierra Nevada, as well as the various mountain ranges in Southern California. For more information on the biology and distinguishing characteristics of drywood, dampwood, and other termite species common in California, see Pest Note: *Subterranean and Other Termites*, Ebeling (1975), and Potter (2011) listed in References. Dampwood termites are less common and cause less costly structural damage than drywood or subterranean termites. Once correctly diagnosed, the problems they cause can best be handled by correcting moisture problems (e.g., water leaks in roofs and decks) and replacing damaged wood. All of the remaining comments in this publication pertain to identification, detection, and management of drywood termites.

IDENTIFICATION AND DETECTION

Drywood termites are cryptic insects that are difficult to detect. They live deep inside wood; and except during periods when they swarm or when repair work is being done on infested homes, they are seldom seen. Colonies are small (usually fewer than 1,000 individuals), can be widely dispersed, and take years to mature. The most common sighting of drywood termites is flying adults (called swarmers) that occur during daytime hours during summer and fall. Dampwood termites also can swarm during summer and fall, but they can be differentiated from the western drywood termite based on their larger size (Figure 2) and attraction to lights at dark. In parts of southeastern California another species of drywood termite, *Marginitermes hubbardi*, and species of desert subterranean termites may also swarm to lights.

While a homeowner may initially detect the presence of drywood termites when they swarm or if fecal pellets are discovered (Figure 3), inspecting and determining the extent of an infestation requires experience and is best done by a professional. By California state law, the minimum requirement for termite inspections includes visual searches of accessible areas. However, detection of difficult-to-find infestations may require removing walls, paneling, and stucco, as well as using ladders and scaffolds.

During a structural inspection for drywood termites, inspectors look for feeding damage, shed wings, fecal pellets, and kickout holes, i.e. small holes (less than 2mm in diameter) through

Figure 1. Western drywood termite, *Incisitermes minor*. Starting on the left side of image are swarmer (alate, reproductive), soldier, and worker. Ruler in image is in inch and centimeter increments. (R. L. Tabuchi, U.C. Berkeley)

Figure 2. Nevada dampwood termite, *Zootermopsis nevadensis*. Starting on the left side of image are worker, soldier, nymph with wing pads, and swarmer (alate, reproductive). Ruler in image is in inch and centimeter increments. (R. L. Tabuchi, U.C. Berkeley)

Figure 3. The fecal pellets produced by drywood termites are elongate with rounded ends and have six flattened or roundly depressed surfaces separated by six longitudinal ridges. Ruler in image is in inch and centimeter increments. (R. L. Tabuchi, U.C. Berkeley)

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which termites push fecal pellets out of the wood. These fecal pellets have six hexagonal sides and are diagnostic for drywood termites (Figure 3 and 4). However, it is not possible to determine, from fecal pellets alone, whether the infestation is currently active or how extensively the infestation extends throughout the wooden piece or structure. Dampwood termites also produce fecal pellets that are rounded at both ends (football shaped) and elongated, but they lack the clear longitudinal ridges common to drywood termite pellets. Other structural pests that can be confused through differential diagnosis include wood boring beetles and carpenter ants, see the *Wood Boring Beetles of the Home* and *Carpenter Ants* pest notes. The final confirmation of drywood termite pellet identification from other wood destroying pests or wood debris may require help from an expert. Cleaning up the fecal pellets around a kickout hole and checking a few days later to see if new pellets have appeared can help to determine if an infestation is active (as building vibrations and movement may also cause some pellets to appear).

Other detection methods that have been commercialized and tried by the pest control industry include dogs, feeding-sensitive (acoustic emission) devices, fiber-optical devices, movement-sensitive (microwave-based) devices, and odor detectors; but these methods are infrequently used. Visual inspection by inspectors for evidence of termites and damage remain the mainstay of the industry.

MANAGEMENT

Because of the difficulty in detecting drywood termites and determining the extent of the damage, do-it-yourself treatments are not recommended. In addition, the products needed for controlling these pests are not available for homeowner use. Except for wood removal, homeowners should seek help for infestations of drywood termites from pest control professionals. This publication is intended to provide homeowners with sufficient background information so they can better discuss treatment options with pest control professionals; it is not intended as a treatment guide.

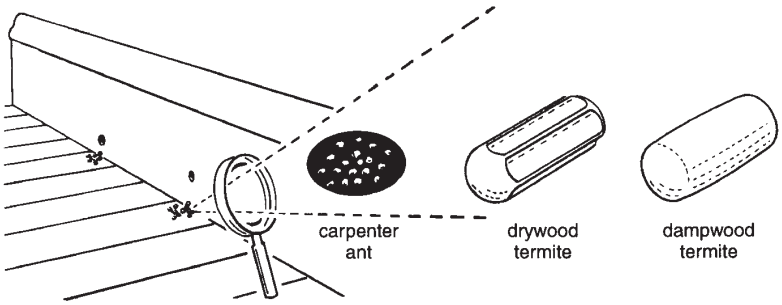

Figure 4. Comparison of fecal pellets produced by carpenter ants, drywood termites, and dampwood termites. (D. Kidd)

Existing Infestations

All drywood termite control methods can be categorized as either whole structure or localized. A whole-structure treatment is defined as the simultaneous treatment of all infestations, accessible and inaccessible, in a structure. Localized or spot treatment is more restrictive and is often applied to a single board or small group of boards. Homeowners are advised to understand the distinction between whole-structure and localized treatments when deciding which method to select, because all treatment methods are not equal. Whole-structure treatments have an advantage over localized treatments in that they should eliminate all infestations, even hidden ones. With the uncertainty of current detection methods, particularly when drywall or other wall coverings conceal infestations, there is always some doubt as to the extent of drywood termite colony boundaries and the number of colonies within homes. Consequently, one can never be sure all infestations have been treated when applying localized treatments. The strengths and limitations of whole-structure vs. localized treatments are outlined in Table 1.

Whole-structure Treatment. Sulfuryl fluoride treats all infestations simultaneously and has high levels of efficacy, if correctly applied. Sulfuryl fluoride kills drywood termites within several days. A monitored fumigation, which involves installing gas monitoring lines inside the structure undergoing treatment, has the highest rate of treatment success. Nonmonitored fumigation may not have enough gas concentration to kill infestations, and failures may occur. The advantage of fumigation over localized treatment is that it should eliminate infestations hidden from view. It will also be necessary for the occupants, pets, and plants to vacate the structure for several days (depending on volume of structure and amount of gas injected) while it is being fumigated and then aerated. Additionally, roofs could be damaged as a result of having tarpaulins dragged across them.

Heat is a nonchemical option for whole-structure treatment. The treatment process involves heating all wood in the structure to a minimum of 120°F and holding this temperature for at least 33 minutes. The benefit of heat treatment is the ability to treat the entire structure without using chemicals and the relatively short period of time the structure must be vacated—hours instead of days, as with fumigation. An additional advantage is that portions of large structures can be treated separately, which is very useful in apartments and condominiums. The major drawbacks of heat treatments include the difficulty in raising the internal core temperature of large infested structural beams (could take many hours or days depending on wood volume treated) and the potential for heat sinks, areas within the structure that are difficult to heat such as wood on concrete or tile. New heat emitters have been developed, but the ability of these heating devices to rid all infesta-

tions from large structures with many layers of wall coverings still remains unclear. Other issues to consider include damage to heat-sensitive items in homes, including plastics (e.g. electrical outlet covers) and cable wiring. Also, like fumigants, heat treatments have no residual effect. For long-term protection, preventive chemicals (Table 3) can be applied to areas treated with fumigants or heat.

Localized Treatments. There are many localized treatment methods available that include both chemical and nonchemical options (Table 2). For liquid and dust insecticides to be effective, termites must make contact with them or ingest them. Localized treatments should be applied only by licensed applicators. Home-use products are not effective. Depending on the material used for localized treatments, laboratory and field studies have shown considerable variation in their effectiveness in controlling drywood termites (see Lewis and Rust 2009, Lewis, et al. 2009, Rust and Venturina 2009, Lewis and Forschler 2014 in References). Research indicates that if you correctly locate the colony and get the chemical or nonchemical treatment directly onto the termites, the effectiveness of control will be high. For failed treatments, an additional callback treatment may lead to better results; and the use of termite detection equipment enhances the performance of any localized treatments applied. Botanical-based products (e.g., orange oil and neem oil) have been tried, but recent lab and field tests from two universities question the efficacy of at least d-limonene (Lewis and Rust 2009, Lewis, et al. 2009 in References).

There are four nonchemical options for drywood termite control with localized or spot application (Table 2), including heat, which is used for both spot and whole-structure treatments. The advantages and disadvantages discussed for heat as a whole-structure treatment also apply to spot treatments.

Microwave devices are also available for control. Microwaves kill termites by causing fluids inside their cells to boil, which destroys cell membranes; in short, the termites are cooked inside the wood. There are few firms now offering microwave treatments. One advantage of microwaves is their relative portability; another is that they leave no chemical residue. When using microwaves, however, detection accuracy is critical to success. Microwaves may damage the surface or interior of wooden boards, depending on the power

Table 1. Existing Infestations—Whole Structures: Summary of Commercially Available Options.[1]

Treatment	Efficacy in Field	Strengths	Considerations and Limitations	Damage to Structure
fumigants	high level of efficacy if monitored	hidden sites treated	correct dosage must be achieved; residents must leave house for days; no residue; recently labelled greenhouse gas	gas pilots must be extinguished before treatment; possible damage to roof from tarpaulins or if walked on
heat	efficacy variable depending on structural size and amount of wall covering & furnishing	hidden sites treated	lethal temperature must be achieved in the core of all infested wood; no residue; heat sinks may affect efficacy	possible damage to roof if walked on; possible damage to some heat-sensitive household items

Table 2. Localized or Spot Treatments: Summary of Commercially Available Options.[1]

Treatment	Efficacy in Field	Strengths	Considerations and Limitations	Damage to Structure
Chemical				
chemical liquids and dusts	efficacy highest if infestation is accessible, exposed and detection equipment used	long-term	many active ingredients commercially available; detection accuracy critical; chemical residue; results vary with active ingredient used and concentration; infestation may rebound	yes, if drill holes for injection used
chemical foams	same as above	coverage of hidden infestation; long-term	some recent published lab studies show highly variable efficacy results	yes, if drill holes for injection used
Nonchemical				
biological control	no information	no chemicals	unreliable at this time; more research needed	
electrocution	highly variable	portable	detection accuracy critical; many disclaimers; infestation may rebound	yes, if drill holes for injection used
microwaves	highly variable	semi-portable	detection accuracy critical; highly dependent on treatment time and wattage; heat sinks may affect efficacy; limited availability	may be to wood or household items

[1] Sources: Lewis et al. 2009, Lewis and Rust 2009, Rust and Venturina 2009, Lewis and Forschler 2014.

of the device; the wattage or power of microwaves may vary from several hundred to more than 10,000 watts. Lab studies revealed no relationship between increasing microwave wattage and drywood termite mortality. As with heat treatments, it may be difficult to use microwaves to heat areas with potential heat sinks to high enough temperatures for effective control.

High voltage electricity, or electrocution, is another nonchemical option. The device used emits high voltage (90,000 volts) but a low current (less than 0.5 amps). Death to drywood termites occurs by electric shock, although delayed mortality may also occur from the destruction of intestinal protozoa. The advantage of electrocution is that the equipment is portable. The limitations include detection accuracy and possible reduced efficacy from the interfering actions of common building materials (e.g., metal, concrete, and glass). If drill holes are used to enhance the flow of the current into wood, some damage occurs to wall coverings, walls, and structural wood members.

Table 3. Preventing New Drywood Termite Infestations: Summary of Commercially Available Options.[1]

Treatment	Efficacy in Field	Strengths	Considerations and Limitations	Damage to Structure
Chemical				
chemical liquids and dusts	variable and best for interior applications protected from the leaching effects of rain	long-term	many active ingredients available; chemical residue; results vary depending on active ingredient used and concentration; infestation may rebound	possible land fill contamination if and when damaged wood removed
pressure-treated wood	variable depending on exterior versus interior use and degree of drilled holes and carpentry cuts from lumber installation	long-term	few active ingredients commercially available; chemical residue; results vary with active ingredient used and concentration; environmental persistence	possible land fill contamination if and when damaged wood removed
Nonchemical				
barriers (screens and paint)	no information	long-term	barriers degrade and can be breached; some feeding damage may occur	N/A
resistant woods	highly variable	long-term	depending on species of wood; degree of heartwood versus sapwood; costly; limited availability	N/A

[1]Source: Lewis and Forschler 2014.

Wood replacement is another remedial treatment option. However, similar to other localized treatments, its effectiveness is highly dependent on detection accuracy, as well as the extent and location of the infestation. Furthermore, if the infested wood is load-bearing either an architect, engineer, and/or general contractor should be consulted; and building permits may be necessary, adding expense. Lastly, the use of insect pathogens and parasites directed at drywood termite control has been limited, and most attempts have been reported as failures.

Long-term Preventive Treatments. Table 3 lists approaches to preventing drywood termites from attacking uninfested wood. Methods include chemical treatments, pressure-treated wood, barriers, and resistant wood species. Wood preservatives and pressure-treated wood (i.e., chemically treated wood that is green and sometimes brown in color) are commonly used for structural pest prevention in California. However, efficacy can be less than expected due to differences in wood destroying pest susceptibility, concentration and penetration of active ingredients in wood, the degree of drilled holes and carpentry cuts in lumber used for installation leading to breaches in chemical barrier, and leaching of chemical from exterior applications due to rain.

Currently, dozens of chemical products are registered in federal and state databases for long-lasting prevention against drywood termite infestations. However, although simulated field trials have shown efficacy of some products against drywood termites in Florida, there are no field studies documenting their field performance on drywood termites that occur in California. This type of research would be required to formulate guidelines for use of preventive chemicals in California. Drawbacks with some chemical preventive treatments may include damage from drill holes, unsightly appearance from applying dusts, and potential hazards of some products to applicators.

Did I make the right choice?

When planning treatment of your building for drywood termite control, consider whether the whole structure is to be treated or just localized areas. Localized treatment methods make it more challenging to ensure complete control because of the difficulty in determining the extent of a drywood termite infestation. There also appears to be considerable variation in effectiveness of various techniques from applicator to applicator. Read your guarantee carefully; you may wish to consider an annual inspection service.

Also important is a company's reputation. There are thousands of pest control companies in the state, but they don't all have the same services or quality of performance. Obtain at least three structural inspection reports before you decide. Check the reliability of the vendor by asking for client referrals, and check the status of its business license and consumer complaints with the California Structural

Pest Control Board in Sacramento or your local Better Business Bureau. For added information regarding the safety of chemicals to humans and structures, request the Safety Data Sheets, or equivalent information, for nonchemical control methods, from the pest control company.

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AUTHORS: V. R. Lewis, Environmental Science, Policy, and Management, UC Berkeley**; A. M. Sutherland,** UC Statewide IPM Program, Alameda Co.; and **M. I. Haverty,** Environmental Science, Policy, and Management, UC Berkeley

TECHNICAL EDITORS: M. L. Flint and K. Windbiel-Rojas
EDITOR: K. Beverlin

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University of California
2801 Second St.
Davis, CA 95618-7774