TERMITES

Integrated Pest Management in and around the Home

Termites are small, white, tan, or black insects that can cause severe destruction to wooden structures. Termites belong to the insect order Isoptera, an ancient insect group that dates back more than 100 million years. The Latin name Isoptera means "equal wing" and refers to the fact that the front set of wings on a reproductive termite is similar in size and shape to the hind set.

Although many people think termites have only negative impacts, in nature they make many positive contributions to the world's ecosystems. Their greatest contribution is the role they play in recycling wood and plant material. Their tunneling efforts also help to ensure that soils are porous, contain nutrients, and are healthy enough to support plant growth. Termites are very important in the Sahara Desert where their activity helps to reclaim soils damaged by drying heat and wind and the overgrazing by livestock.

Termites become a problem when they consume structural lumber. Each year thousands of housing units in the United States require treatment for the control of termites. Termites may also damage utility poles and other wooden structures. Termite pests in California include drywood, dampwood, and subterranean species. These pests cause serious damage to wooden structures and posts and may also attack stored food, books, and household furniture.

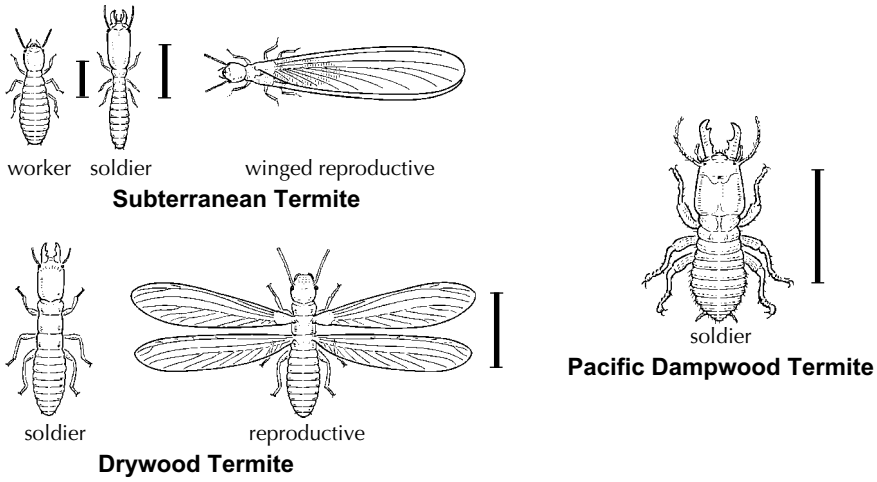

Figure 1. Subterranean, drywood, and dampwood termites.

IDENTIFICATION

Termites are social and can form large nests or colonies, consisting of very different looking individuals (castes).

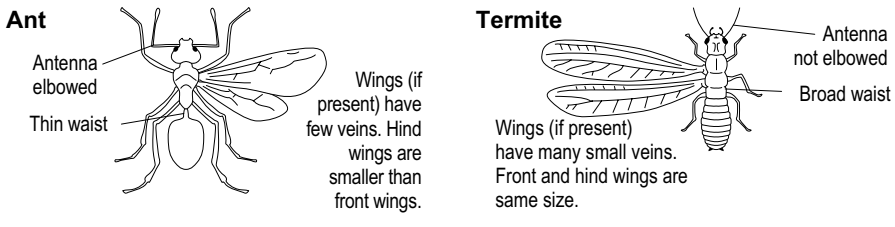

Figure 2. Distinguishing features of ants and termites.

Physically the largest individual is the queen. Her function is to lay eggs, sometimes thousands in a single day. A king is always by her side. Other individuals have large heads with powerful jaws, or a bulblike head that squirts liquid. These individuals are called soldiers. But the largest group of termites in a colony is the workers. They toil long hours tending the queen, building the nest, or gathering food. While other species of social insects have workers, termites are unique among insects in that workers can be male or female. Surprisingly, termites can be long-lived: queens and kings can live for decades while individual workers can survive for several years.

Signs of termite infestation include swarming of winged forms in fall and spring and evidence of tunneling in wood. Darkening or blistering of wooden structural members is another indication of an infestation; wood in

PEST NOTES Publication 7415

University of California
Agriculture and Natural Resources

Revised May 2001

damaged areas is typically thin and easily punctured with a knife or screwdriver.

There are more than 2,500 different types of termites in the world and at least 17 different types of termites in California. However, most of this diversity can be lumped into four distinct groups: dampwood, drywood, subterranean, and mound builders. Mound builders do not occur in North America, but the other three species do (Fig. 1). Dampwood termites are very limited in their distribution: most species are found only in California and the Pacific Northwest. Dampwood termites derive their name from the fact that they live and feed in very moist wood, especially in stumps and fallen trees on the forest floor. Drywood termites are common on most continents and can survive in very dry conditions, even in dead wood in deserts. They do not require contact with moisture or soil. Subterranean termites are very numerous in many parts of the world and live and breed in soil, sometimes many feet deep. Lastly, the mound builders are capable of building earthen towers 25 feet or more in height. Mounds may be located either in the soil or in trees, and where they occur in Africa, Australia, Southeast Asia, and parts of South America, they are very noticeable and remarkable.

Termites are sometimes confused with winged forms of ants, which also leave their underground nests in large numbers to establish new colonies and swarm in a manner similar to that of reproductive stages of termites. However, ants and termites can be distinguished by checking three features: antennae, wings, and waist (Fig. 2).

Dampwood Termites

Dampwood termites are fairly common in central and northern coastal areas in California. They nest in wood buried in the ground, although contact with the ground is not necessary when infested wood is high in moisture. Because of their high moisture requirements, dampwood termites most often are found in cool, humid areas along the coast and are typical pests of beach houses. Winged reproductives typically swarm between July and October, but it is not unusual to see them at other times of the year. Dampwood termite winged reproductives (sometimes called swarmers) are attracted to lights.

Dampwood termites produce distinctive fecal pellets that are rounded at both ends, elongate, and lack the clear longitudinal ridges common to drywood termite pellets (Fig. 3). Final confirmation of pellet identification may require help from an expert.

The Nevada dampwood termite, *Zootermopsis nevadensis*, occurs in the higher, drier mountainous areas of the Sierras where it is an occasional pest in mountain cabins and other forest structures; it also occurs along the northern California coast. The Pacific dampwood termite, *Zootermopsis angusticollis*, is almost one inch long, making it the largest of the termites occurring in California. Winged reproductives are dark brown with brown wings. Soldiers have a flattened brown or yellowish brown head with elongated black or dark brown mandibles. Nymphs are cream colored with a characteristic spotted abdominal pattern caused by food in their intestines. Nevada dampwood termites are slightly smaller and darker than the Pacific species; reproductives are about ¾ inch long.

Drywood Termites

Drywood termites infest dry, undecayed wood, including structural lumber as well as dead limbs of native trees and shade and orchard trees, utility poles, posts, and lumber in storage. From these areas, winged reproductives seasonally migrate to nearby buildings and other structures usually on sunny days during fall months. Drywood termites are most prevalent in southern California (including the desert areas), but also occur along most coastal regions and in the Central Valley.

Drywood termites have a low moisture requirement and can tolerate dry conditions for prolonged periods. They remain entirely above ground and do not connect their nests to the soil. Piles of their fecal pellets, which are distinctive in appearance, may be a clue to their presence. The fecal pellets are elongate (about $^{3}/_{100}$ inch long) with rounded ends and have six flattened or roundly depressed surfaces separated by six longitudinal ridges (see Fig. 3). They vary considerably in color, but appear granular and salt and pepperlike in color and appearance.

Winged adults of western drywood termites *(Incisitermes minor)* are dark brown with smoky black wings and have a reddish brown head and thorax; wing veins are black. These insects are noticeably larger than subterranean termites.

Subterranean Termites

Subterranean termites require moist environments. To satisfy this need, they usually nest in or near the soil and maintain some connection with the soil through tunnels in wood or through shelter tubes they construct (Fig. 4). These shelter tubes are made of soil with bits of wood or even plasterboard (drywall). Much of the damage they cause occurs in foundation and structural support wood. Because of the moisture requirements of subterranean termites, they are often found in wood that has wood rot.

The western subterranean termite, *Reticulitermes hesperus,* is the most destructive termite found in California. Reproductive winged forms of subterranean termites are dark brown to brownish black, with brownish gray wings. On warm, sunny days follow-

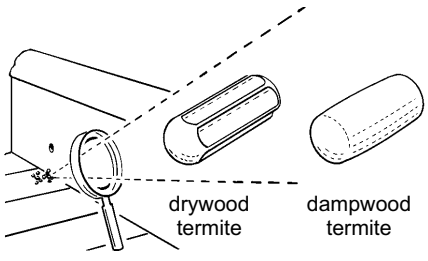

Figure 3. Fecal pellets of drywood and dampwood termites.

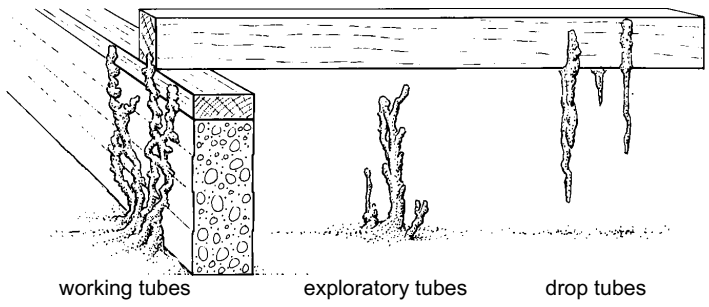

Figure 4. Subterranean termites construct three types of tubes or tunnels. Working tubes (left) are constructed from nests in the soil to wooden structures; they may travel up concrete or stone foundations. Exploratory and migratory tubes (center) arise from the soil but do not connect to wood structures. Drop tubes (right) extend from wooden structures back to the soil.

ing fall or sometimes spring rains, swarms of reproductives may be seen. Soldiers are wingless with white bodies and pale yellow heads. Their long, narrow heads have no eyes. Workers are slightly smaller than reproductives, wingless, and have a shorter head than soldiers; their color is similar to that of soldiers. In the desert areas of California, *Heterotermes aureus*, is the most destructive species of subterranean termites. Another destructive species in this group, the Formosan subterranean termite, *Coptotermes formosanus*, is now in California but restricted to a small area near San Diego. Unlike the western subterranean termite, Formosan subterranean termites swarm at dusk and are attracted to lights.

LIFE CYCLE

Most termite species swarm in late summer or fall, although spring swarms are not uncommon for subterranean and drywood termites. New kings and queens are winged during their early adult life but lose their wings after dispersing from their original colony. An infestation begins when a mated pair finds a suitable nesting site near or in wood and constructs a small chamber, which they enter and seal. Soon afterward, the female begins egg laying, and both the king and queen feed the young on predigested food until they are able to feed themselves. Most species of termites have microscopic, one-celled animals called protozoa within their intestines that help in converting wood (cellulose) into food for the colony.

Once workers and nymphs are produced, the king and queen are fed by the workers and cease feeding on wood. Termites go through incomplete metamorphosis with egg, nymph, and adult stages. Nymphs resemble adults but are smaller and are the most numerous stage in the colony. They also groom and feed one another and other colony members.

MANAGEMENT

Successful termite management requires many special skills, including a working knowledge of building construction. An understanding of termite biology and identification can help a homeowner detect problems and understand methods of control. In most cases it is advisable to hire a professional pest control company to carry out the inspection and control program.

Management techniques vary depending on the species causing an infestation. Multiple colonies of the same species of termite or more than one species of termite can infest a building (Fig. 5). Any of these variables will influence your control approach. Subterranean, and less frequently, dampwood termites can have nests at or near ground level, so control methods for these can be similar. However, drywood termites nest above ground, therefore the approach for eliminating them is unique.

Use an integrated program to manage termites. Combine methods such as modifying habitats, excluding termites from the building by physical and chemical means, and using mechanical and chemical methods to destroy existing colonies.

Inspection

Before beginning a control program, thoroughly inspect the building. Verify that there are termites, identify them, and assess the extent of their infestation and damage. Look for conditions within and around the building that promote termite attack, such as excessive moisture or wood in contact with the soil. Because locating and identifying termite species is not always easy, it may be advisable to have a professional conduct the inspection.

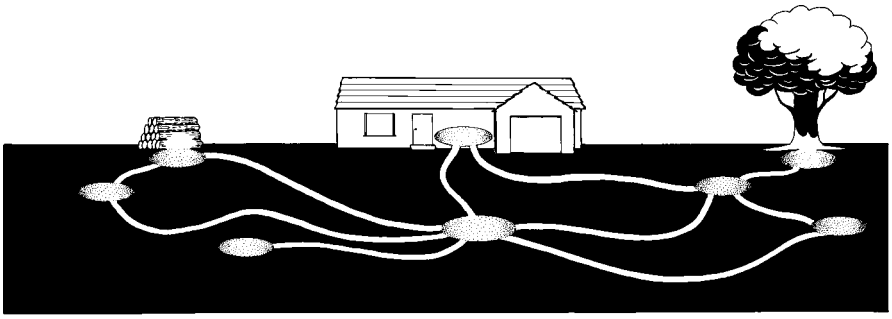

Figure 5. Subterranean termite colony with multiple nesting sites.

Table 1. Relative Resistance of Lumber to Termites[1]

Moderately or very resistant	Moderately resistant	Slightly resistant or nonresistant
Arizona cypress	bald cypress (young growth)	alder
bald cypress (old growth)	Douglas fir	ashes
black cherry	eastern white pine	aspens
black locust	honey locust	basswood
black walnut	loblolly pine	beech
bur oak	longleaf pine	birches
catalpa	shortleaf pine	black oak
cedars	swamp chestnut oak	butternut
chestnut	tamarack	cottonwood
chestnut oak	western larch	elms
gambel oak		hemlocks
junipers		hickories
mesquite		maples
Oregon white oak		pines
osage orange		poplars
Pacific yew		red oak
post oak		spruces
red mulberry		true firs
redwood		
sassafras		
white oak		

Adapted from: *Wood Handbook: Wood as an Engineering Material.* USDA Agriculture Handbook No. 72.

[1] The heartwood of the tree offers the greatest resistance to termite attack.

Prevention

Building design may contribute to termite invasion. Keep all substructural wood at least 12 inches above the soil beneath the building. Identify and correct other structural deficiencies that attract or promote termite infestations. Stucco siding that reaches the ground promotes termite infestations. Keep attic and foundation areas well ventilated and dry. Use screening over attic vents and seal other openings, such as knotholes and cracks, to discourage the entry of winged drywood termites. Although screening of foundation vents or sealing other openings into the substructure helps block the entry of termites, these procedures may interfere with adequate ventilation and increase moisture problems, especially if a very fine mesh is used in the screening. Inspect utility and service boxes attached to the building to see that they are sealed and do not provide shelter or a point of entry for termites. Reduce chances of infestation by removing or protecting any wood in contact with the soil. Inspect porches and other structural or foundation wood for signs of termites. Look for and remove tree stumps, stored lumber, untreated fence posts, and buried scrap wood near the structure that may attract termites. Consult your local city building codes before beginning repairs or modifications.

Recent research has proved the effectiveness of foundation sand barriers for subterranean termite control. Sand with particle sizes in the range of 10 to 16 mesh is used to replace soil around the foundation of a building and sometimes in the crawl space. Subterranean termites are unable to construct their tunnels through the sand and therefore cannot invade wooden structures resting on the foundation. Stainless steel screening may also be available soon as a physical barrier for subterranean termites.

Replacing Lumber in Structures. Structural lumber in buildings is usually Douglas fir, hemlock, or spruce. Of these materials, Douglas fir is moderately resistant to termites, whereas the other two are not (Table 1). Lumber used in foundations and other wood in contact with the soil may be chemically treated to help protect against termite damage in areas where building designs must be altered or concrete cannot be used.

The most effective method of chemically treating wood is through pressure treatment. Chemicals currently used in pressurized treatments include chromated copper arsenate (CCA), ammoniacal copper zinc arsenate (ACZA), disodium octoborate tetrahydrate (DOT), and wolman salts (sodium fluoride, potassium bichromate, sodium chromate, and dinitrophenol). Wood containing CCA is tinted green and ACZA is brownish. DOT (borate) is clear in appearance on the wood surface when used at labeled amounts. Borates are gaining in popular usage because of their low mammalian toxicity.

Many of the chemicals used in pressurized lumber can also be applied topically to the wood by brushing or spraying it on. Pressure treatment is preferred over topical application because the chemical penetrates the lumber much deeper (1/4 to 1/2 inch) than it does when applied by brush or spray. Some of the more porous lumbers such as the southern yellow pines (loblolly–*Pinus taeda*; longleaf–*P. palustris*; and shortleaf–*P. echinata*) may be completely penetrated by the chemical during the pressurized process. Topical applications are most effective when used as spot treatments on pressure-treated lumber to treat newly exposed wood when the lumber is cut and drilled during construction.

Pressure-treated lumber is toxic to termites and discourages new kings and queens from establishing colonies in it. If susceptible wood is used above the treated wood, however, subterranean termites can build their shelter tubes over chemically treated wood and infest untreated wood above.

Use only "exterior grade" pressure-treated lumber for areas that are exposed to weather; otherwise the chemical in the lumber may leach from

the wood. All topical treatments, especially borates, that will be exposed to weather, must also have a sealer coat to prevent leaching into the soil following rain. Because they contain pesticides, disposal of treated lumber requires special handling. For more information on proper disposal of treated lumber, contact your local Household Hazardous Waste Collection site. For the site nearest you, call 1-800-253-2687.

Treating Lumber in Structures. Treating infested lumber in a structure requires drilling and injecting chemicals into the wood to reach the colony. Because of toxicity and complexity of use, most wood preservatives that are applied to wood in a structure are professional-use only.

Controlling Drywood Termites

Drywood termite colonies are usually small and difficult to detect. Treatments for this pest include whole-structure applications of fumigants or heat and localized or spot treatments of chemicals or treatments that use heat, freezing, microwaves, or electricity. Techniques to prevent infestations of this species include the use of chemicals, pressure-treated wood, barriers, and resistant woods. For more details on these control methods and their effectiveness, see *Pest Notes: Drywood Termites*, listed in "Compiled From."

Controlling Subterranean and Dampwood Termites

Subterranean and dampwood termites in structures cannot be adequately controlled by fumigation, heat treatment, freezing, or termite electrocution devices because the reproductives and nymphs are concentrated in nests near or below ground level in structures out of reach of these control methods. The primary methods of controlling these termites are the application of insecticides or baiting programs.

Use of insecticides or baits should be supplemented with the destruction of their access points or nests. To facilitate control of subterranean termites, destroy their shelter tubes whenever possible to interrupt access to wooden substructures and to open colonies to attack from natural enemies such as ants. For dampwood termites, if infestations are small, destroy accessible nests by removing infested wood. Removing excess moisture from wood will also destroy dampwood termite nests.

Insecticides. Insecticides are applied to the soil either in drenches or by injection. Special hazards are involved with applying insecticides to the soil around and under buildings and a licensed professional does these procedures best. Applications in the wrong place can cause insecticide contamination of heating ducts, radiant heat pipes, or plumbing used for water or sewage under the treated building. Soil type, weather, and application techniques influence the mobility of insecticides in the soil; soil-applied insecticides must not leach through the soil profile to contaminate groundwater.

In the past, chlorinated hydrocarbon insecticides (e.g., chlordane) and organophosphates (chlorpyrifos) were extensively used for termite control but many of these materials have been phased out because of health and environmental concerns. Active ingredients in currently available termiticides can be broadly classified as repellent or nonrepellent. Pyrethroids, such as permethrin and cypermethrin (Dragnet and Demon), are considered to be repellent. This means that the termites are able to detect the insecticide, which basically serves as a barrier, and they are repelled by it without receiving a dose that will kill them. Therefore, when using these materials it is important to make sure there are no gaps or breaches in the barrier. Also, any adjoining structures must be monitored to ensure that the repelled termites don't infest them.

Recently introduced chemicals (imidacloprid and fipronil) are now available that are less toxic to humans and other mammals than the older insecticides but highly toxic to insects. Both of these insecticides are also nonrepellent to termites and have been shown to be effective in killing termites at low dosage rates under California's climatic conditions. Generally, the most effective insecticides are only available to licensed structural pest control operators.

Baiting. Baits for subterranean termites are commercially available in California. While this method of controlling termites is very appealing because it does not require extensive site preparation such as drilling or trenching and extensive application of insecticide to the soil or structure, research is still ongoing to develop the most effective baits and delivery systems.

Several bait products (e.g., Sentricon with hexaflumuron and FirstLine with sulfluramid) are available for professional use only. There is also an over-the-counter product (Terminate with sulfluramid) available in retail stores. Currently, baits are only available for subterranean termites, not drywood or dampwood termites. Because subterranean termites in California vary in their foraging and in the times that they will take baits, the placement of bait stations and the time of installation is a crucial component in a successful baiting program. Be sure to read and follow all the label directions for the product you use. Once a termite infestation is controlled, it is essential that the bait stations continue to be monitored monthly. Spring is an especially critical time to detect invasion by new colonies.

Other Methods. Experimental efforts have been made to control soil-dwelling termites using biological control agents, including use of Argentine ants and nematodes. However, these methods are not yet effective enough to be recommended.

COMPILED FROM:

Lewis, V. R. July 1997. *Pest Notes: Drywood Termites*. Oakland: Univ. Calif. Agric. Nat. Res. Publ. 7440. Also available online at www.ipm.ucdavis.edu

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International:
UNEP/FAO/Global IPM Facility Workshop on Termite Biology and Management, www.chem.unep.ch/pops/pdf/termrpt.pdf

For more information contact the University of California Cooperative Extension or agricultural commissioner's office in your county. See your phone book for addresses and phone numbers.

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ILLUSTRATIONS: Figs. 1, 3, 4: D. Kidd; Fig. 2: Adapted from *Termites and Other Wood-Infesting Insects.* Oakland: UC DANR Leaflet 2532; Fig. 5: Adapted from Mallis, A. 1997. *Handbook of Pest Control.* 8th ed. Cleveland: Franzak & Foster Co.

Produced by IPM Education and Publications, UC Statewide IPM Project, University of California, Davis, CA 95616-8620

This Pest Note is available on the World Wide Web (http://www.ipm.ucdavis.edu)



This publication has been anonymously peer reviewed for technical accuracy by University of California scientists and other qualified professionals. This review process was managed by the ANR Associate Editor for Pest Management.

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This material is partially based upon work supported by the Extension Service, U.S. Department of Agriculture, under special project Section 3(d), Integrated Pest Management.