



DRYWOOD TERMITES

In nature, termites function as decomposers that break-down dead wood that accumulates in and on the soil. The beneficial products of this breakdown process are returned to the soil as humus. Drywood and subterranean termites are the most destructive insect pests of wood, causing more than \$1.7 billion in damages and cost of control each year in the U.S. alone. Their presence in structures is seldom noticed until damage is discovered or the termites swarm within the building.

Drywood termites are found in the southern tier of states, from North Carolina through the Gulf Coast, Arizona and into the coastal areas of California.

General Biology

Drywood termites are social insects that live in colonies in sound, dry wood. Each colony consists of offspring from an original pair (male and female). There are three growth stages – eggs, immatures and adults. Drywood termites are larger than local, southwestern subterranean species.

In comparison to other termites, drywood colonies are rather small (a few thousand individuals), and the colony develops relatively slowly. They neither live in the ground nor maintain contact with the soil, and they do not build mud tubes.

Subterranean termites produce liquid feces, whereas drywood termites produce characteristic dry pellets. These pellets are eliminated from the galleries through “kick holes”. Pellets tend to accumulate on surfaces located below the kick holes and are usually the first evidence of a drywood termite infestation.

Drywood termites tend to cut across wood grain destroying both the soft spring wood and the harder summer growth. Subterranean termites typically follow the grain of the wood, feeding primarily on the soft spring wood.

The reproductives are winged (alates or swarmers) or wingless males and females that produce offspring. The primary reproductives, also called swarmers or alates, vary in body color from dark brown to light yellowish tan. Their wings may be almost clear to smoke gray, and have few distinct veins in them. Swarmer drywood termites are about 7/16 inch (11mm) long, including the wings. If the primary reproductives die, they are replaced by immatures that can become capable of



Alates or Swarmers



Soldiers

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Immatures

reproductive activity. They are known as replacement or secondary reproductives.

In most drywood species there is no true worker caste (subterranean termites do have a true worker cast); this function is taken over by immatures. These immatures are wingless, white to beige in color, 1/4 to 3/8 inch (6 -10mm) long and make up the largest number of individuals within a colony. They gather food, enlarge the nest and feed and care for the queen, younger immature forms and others in the colony.

Soldiers resemble immatures in color and general appearance. However, they have large, brownish to yellowish-brown heads with enlarged, heavily sclerotized mandibles (jaws). Soldiers defend the colony against invaders, primarily ants. Soldiers are about 5/16 inch (8mm) long.

After a drywood termite colony has matured (several years), winged alates (swarmers) are produced that leave the colony to establish new colonies. Swarming activity (nuptial flights) generally occurs at dusk or during the night and they tend to fly towards areas of greatest light intensity, gathering around lights or illuminated windows. However, the dark western drywood termite (*Incisitermes minor*) is a daytime swarmer. Swarming of most Arizona species occurs in early to late summer with certain species swarming during the winter months of January and February.

Some termite species are very regular down to the time and day of year that nuptial flights are made. Other species vary widely on the day and time. Certain environmental conditions, such as heat, light (time of day), rainfall and moisture conditions, wind, atmospheric pressure (especially rapid changes in pressure) and the electrical properties of the atmosphere (associated with thunderstorms) trigger the emergence of alates, and each species has a definite set of conditions under which swarming will occur. The number of alates produced will be proportionate to the age and size of the colony, while environmental conditions regulate the number of swarms emerging from the colony. The bulk of a colonies alates will be released in one or two synchronized swarms, then a few at a time are released throughout the rest of the season. Swarming constitutes a dispersal stage, rather than a true mating flight.

Male and female alates fly from the colony and travel varying distances. They are extremely weak flyers, but individuals can travel great distances carried by air currents during the summer monsoon season. Any alates that try to return from the outside are usually killed. Often, the soldier castes congregate around colony openings to defend the release of the alates.

Only a small number of the swarmers survive to develop colonies. The majority fall prey to birds, toads, reptiles, insects (primarily ants) and other predators. Many others die from dehydration or injury. When a pair alights, they shed or pull off their wings and immediately attempt to enter wood. Swarmers usually enter wood through cracks, natural checks, overlapping or adjoining pieces, or exposed end grain. A very small nest is developed after the pair has mated. Initially the queen lays relatively few eggs. The male, or king, remains with the female, since periodic mating is required for continued egg development.

Immatures hatch within several weeks and are cared for by the king and queen. After two molts, immatures assume the role of workers and begin to feed and care for the original pair. Eggs are not deposited continuously, and in fact, very few are deposited the first year. In subsequent years, the young queen matures and will lay more eggs. Eventually, the colony stabilizes when the queen reaches maximum egg production. At that point the colony will contain eggs, immatures, soldiers and reproductives. If the queen dies, one or more secondary reproductives take over her duties. The maximum size of a colony depends on factors such as location, food availability and environmental conditions. Most colonies remain small, but multiple colonies in the same piece of wood may contain up to 10,000 individuals. A colony grows through the queen's increased egg production and the accumulation of long-lived individuals.

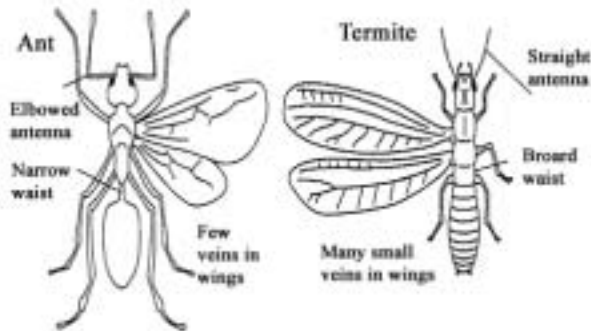
Drywood termites derive their nutrition from cellulose in wood. Within the termite's gut are large numbers of bacteria and single-celled animals called protozoa. The protozoa produce enzymes that digest cellulose causing the break down of wood particles to simpler compounds that termites can absorb as food. The immatures consume wood and share their nourishment with the developing young, soldiers and reproductives.

Moisture is not as important to drywood termites as it is to subterranean termites. Drywood termites require no contact with the soil or with any other source of moisture. They extract water from the wood on which they feed, and also produce water internally during the digestive process. They require as little as 2.5 to 3 percent moisture, but prefer wood with 10 percent moisture content. Drywood termites often establish nests in roof materials and wooden wall supports accessed under eaves.

However, despite being capable of surviving on low wood moisture they are also found in wood associated with a water source such as a leaky pipe or water heater.

Dead wood accumulating around buildings and homes often serves as a source of infestation.

Homeowners most commonly confuse winged ants with termite alates as several species of ants and termites swarm during the same season.



Important Drywood Termite Species of Arizona

DARK WESTERN DRYWOOD TERMITE

Incisitermes minor is the most destructive drywood termite in this country.

Adult *Incisitermes minor* swarm during the daylight hours usually during the months of May through early August in Arizona. They fly into attics and accessible areas of poorly vented houses. A favorite place for entry is in the crack created by drying plaster or stucco as it pulls away from window and door frames. It is necessary for most termites to be able to get a purchase on the wood that they intend to invade. Normally, termites will not just land on wood and be able to tunnel effectively. However, if they can crawl down into cracks and crevices, their chances of successful tunneling is greatly increased.

Dark western drywood termite swarmers are about 7/16 - 1/2 inch (11-12.5 mm) long, including wings, which are 3/8 inch (9.5 mm) or longer. Alates of the dark western drywood termite have an orange brown head and pronotum (first segment of the thorax, behind the head), the abdomen is dark brown, wing membranes and pigmented veins are blackish. The soldiers have orange to reddish brown heads with whitish eyespots. The head slopes down gradually from the top and is flattened to slightly rounded on side view; the antennae have a 3rd segment which is enlarged and club-like; the pronotum is as wide or wider than the head when viewed from the top.

Western drywood termites infest wood with a moisture content of 12% or less.

LIGHT WESTERN DRYWOOD TERMITE

Marginitermes hubbardi is found in the Sonoran desert areas of California and Arizona. It is also referred to as the southern drywood termite. This termite has very similar habits to the dark western drywood termite, but can tolerate drier conditions and higher temperatures.

Alates of the light western drywood termite are pale in color. Soldiers have a club-like third antennal segment that is almost as long as all the succeeding segments combined. This characteristic makes the species easy to distinguish from others.

The reproductives are a uniform light chestnut brown in color, and about 1/4 - 5/6 inch (7-8 mm) in length without wings. This species swarms at dusk May through early September.

Damage

Dead trees, branches, brush and firewood from residential areas are the primary habitat of drywood termites. When land is cleared and houses or other buildings constructed, these structures are then subject to attack. Drywood termites enter structures through attic or foundation vents, directly through or under wood shingles, under eaves and fascia boards, and through natural cracks, checks and joints in exposed wood trim, window and door frames and sills. Drywood termite alates can penetrate flat wood surfaces, but prefer to wedge themselves into narrow places to begin tunneling. Most new homes are constructed on concrete slabs and have tile roofs. However, attic areas are normally vented and external wood trim is still commonly used.

Signs of Infestation

Generally, the first indirect sign of infestation is the discovery of fecal pellets or the presence of alates on window sills or near lights. Alates found inside the house (if windows and doors have been closed), are an indication of infestation within the structure. Another indication of infestation is the presence of discarded wings near emergence sites, on windowsills or caught up in cobwebs. **The presence of alates outdoors is a natural phenomenon and is not an implication of home infestation.**

Drywood termites spend their entire lives inside wood. They construct round "kick holes" in infested wood, through which the fecal pellets are eliminated from the galleries or tunnels. These pellets accumulate in small piles below the kick holes, or will be scattered if the distance between the kick hole and the surface below is great. Fecal pellets also may be found caught in spider webs.

Fecal pellets are distinctive and used for identification of drywood termite infestation. Drywood fecal pellets are hard, elongated and less than 1/25 inch (1mm) long. They



Drywood Termite Fecal Pellets



have rounded ends and six flattened or concavely depressed sides with ridges at angles between the six surfaces. The characteristic shape results when the termite exerts pressure on the fecal material to extract and conserve moisture in its hindgut. Typically the pellets are a light tan in color with some black ones mixed in.

Characteristics of Damaged Wood

Wood, which has a dull or hollow sound when tapped, should be examined closely. Careful probing of wood with a sharp instrument may disclose drywood termite galleries. The interior of infested wood contains chambers connected by galleries or tunnels that cut across the wood grain. The galleries have a smooth, sculptured appearance and contain few if any fecal pellets. Accumulations of pellets sometimes may be found in blind galleries or unused tunnels.

Control

Control measures include reducing the potential for drywood termite infestations, preventing termite entry, removal of infested wood and applying chemicals, or using other techniques for remedial treatment. (See Table)

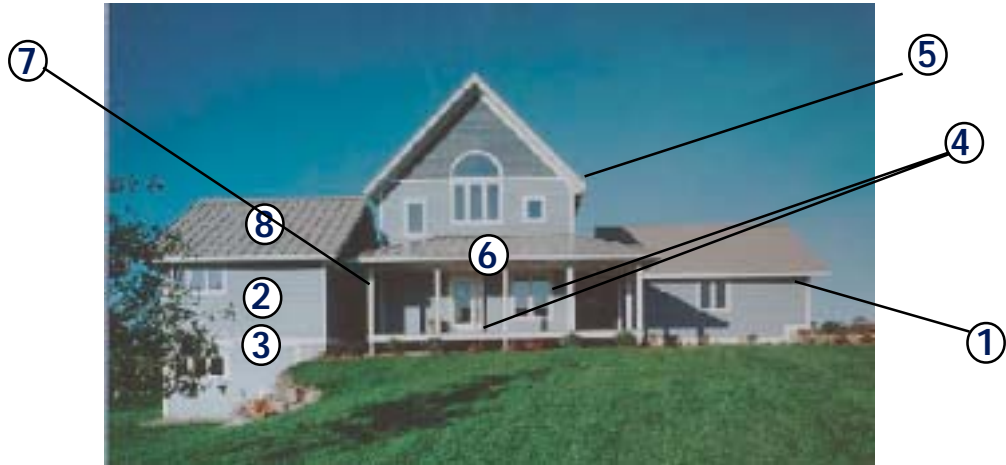


Drywood Termite Tunneling Activity

Inspection

Thorough inspections are necessary to confirm termite infestations, assess the extent of damage and determine whether remedial control measures are necessary. Inspections must be performed by personnel who understands the basic elements of construction, the environmental requirements for termite survival and the behavior of drywood termites. **Reliable insect identification is imperative.** Tools and equipment needed for an inspection include a flashlight, pointed screwdriver, a light hammer, ladder and protective clothing (bump cap, coveralls and knee pads). A clipboard, graph paper and floor plan or sketch help to accurately depict findings and to ensure that no area of the structure has been omitted. The importance of a thorough inspection for drywood termites and their damage cannot be overemphasized, since the various control measures so closely relate to the extent of infestation and the amount of damage. Thorough sounding and probing is necessary to pinpoint the location and extent of infestations. Precautions should be taken to avoid defacing wood surfaces during inspection if at all possible. If an infestation is suspected it is a good idea to conduct an inspection personally as well as request a professional company to do the same.

When inspecting for drywood termites, carefully examine the exterior of the house, particularly the eaves (1) or any wooden siding (2) or exterior trim (3). Carefully check corners or under the eaves for spider webs that may contain fecal pellets. Check window and doorframes (4), sills, roof eaves and exposed ends of rafters (5). Examine and sound porch roofs (6) and supports (7), stair carriages and trellises. Open any exterior electrical meter or fuse boxes set into walls and examine them for fecal pellets. Sound and probe wooden roof shingles (8) and any projection to the roof such as dormers, cornices or wood trim. The ends of shingles at roof eaves are the most common places for infestation. Other commonly infested areas include roof rafters, exposed beams, fascia boards, trim wood, bottom boards of wood siding (especially cedar), foundation beams and floor joists.



Important Inspection Points



Modern homes are often constructed with fewer entry points and less exposed wood

Check the foundation carefully. Examine any wood access doors, doorframes or vents. Probe, sound and examine sills and floor joists, particularly at the perimeter of the building. Look for accumulations of fecal pellets on sill tops. Examine wooden floors closely, especially subflooring and the floor joists below it, for additional damage.

While outdoors, also thoroughly examine buildings such as garages or wooden storage sheds. Carefully check garage interiors, particularly unfinished garages, since doors are commonly left open for long periods and drywood termite swarmers may enter.

Indoors, carefully examine your home on a room-by-room basis, overlooking no area. Examine door and

window frames and trim for damage. Closely examine the baseboards on the perimeter walls, particularly if you have wood flooring. Check window sills for fecal pellets or discarded wings. Check the insides of built-in cabinets by removing drawers and opening doors. Exposed beams and wooden paneling should be examined thoroughly, as well as places that are continually warm such as near water heaters and furnaces.

Drywood termite damage seldom can be observed on the wood surface; however, sometimes painted wooden surfaces will look blistered if termites have tunneled close to the surface. A sign of advanced infestation is surface blistering that can be probed with a sharp screwdriver.

If a section of wood is found to be infested, carefully follow the boards until you get to a solid piece of wood on all sides of the infested area. Removal of infested wood is often all that is required.

Prevention

Quite often, termite problems encountered by homeowners could have been prevented through sound initial design practices, mechanical alterations or sanitation. The basic premise behind prevention is denying termites' access to wood. Preventing drywood termite infestation is more difficult than preventing subterranean species as the outside of homes have many sites where termites may enter. However, certain preventative measures can be effective.

Remove all potential sources of outdoor infestation such as stored lumber, firewood, scrap lumber and dead trees or woody shrubbery. Screen attic or foundation vents with bug screen to exclude drywood termite alates. The screening of vents along with good maintenance of window screens will exclude a multitude of unwanted critters from your home. This may not be practical in areas of high humidity, since it restricts air movement needed to keep attics and subfloor areas dry. However, this is rarely a problem for most of Arizona.

Drywood termites will not enter wood that has a sound coat of paint. Before painting, seal any cracks, natural checks, construction scars, crevices and joints with wood putty. No effective way has been developed to prevent drywood termites from entering under or through wood shingles.

Preconstruction planning offers opportunities for preventing termite infestation. Wooden structural members can be soaked in or painted with borax derived wood preservatives. These materials may not penetrate wood deeply though, so a touch-up will be necessary before closing in the building. Commercially pressure-treated wood is more desirable and may be used as framing members, subflooring, window and doorframes, trim and possibly even wood siding. The extra cost of pressure-treated wood may be justified where termite problems are common.

Treatment

There are several alternatives for dealing with drywood termite infestations or damage, depending on the extent of the problem. This places great importance on an extremely accurate inspection of the structure.

No Control. Where the infestation is slight or damage is cosmetic and limited to one or two small areas, you may choose not to use any control measures. Drywood termite colonies often develop slowly; therefore, the costs incurred with some control measures may not be warranted. But if you choose not to control, be sure to

maintain a monitoring program so you'll know when and if control becomes necessary.

Wood Replacement. Where the infestation is limited, remove and replace damaged wood, preferably with pressure-treated wood that will protect against both termites and wood decay. Or it may be more practical to have a pest control operator apply special formulations of wood preservatives. They penetrate fairly deeply into unpainted wood surfaces, particularly cut ends and structural joints. Certain precautions are necessary to protect ceilings and painted surfaces from staining

Fumigation. If infestations are widespread or suspected in areas that cannot be inspected or replaced (such as in wood shingles, between walls or in eaves or attics), fumigation is a control alternative. First, a structure is completely enveloped in gas-proof tarpaulins or heavy plastic sheeting. Masonry construction with flat, composition shingle roofs may be sealed around the doors, windows and vents. Then a fumigant gas is released into the structure. The gas penetrates into cracks, crevices, void areas and directly into wood to kill termite colonies. Lethal concentrations are contained by the tarpaulins long enough to permit uniform penetration deep into all infested areas.

Despite its effectiveness, there are disadvantages to fumigation. It does not leave any chemical residue to deter future infestation. Fumigation is extremely hazardous and the occupants of the home may have to vacate for several days. Also, fumigation is labor intensive and requires the specialized knowledge of a licensed, professional pest control firm and can be expensive. Fumigation requires special certification because of the extreme hazard. It is imperative to remove all household pets, plants and food products from the home prior to treatment.

Whole-Structure Treatment. Fumigants (methyl bromide and sulfuryl fluoride) treat all infestations simultaneously, and have high levels of control, usually reaching 100% if correctly applied. Major issues to be considered by pest control operators include the difficulty of installing tarpaulins, the difficulty in determining the correct dosage, the need to protectively seal or remove food items, and the lack of residual control. People, animals and plants must vacate structures for 1 to 2 days to allow for treatment and ventilation.

Heat is a nonchemical option for whole-structure treatment. The treatment process involves heating all wood in the structure to a minimum of 124°F (51°C) and holding this temperature for at least 30 minutes. The benefit of heat treatment is the ability to treat the entire structure without the use of chemicals and the relatively short period of time the structure must be vacated (several hours). An additional advantage is that portions

of large structures can be treated separately, which is very useful in apartments and condominiums. The major drawback to using heat is that certain areas within a structure may be difficult to heat, such as wood on concrete (called a heat sink). Other issues to consider include the possible damage to sensitive items in homes.

Localized or Spot Treatments. There are many localized/spot treatment methods available that include both chemical and nonchemical options. The chemical options include liquid organophosphates and pyrethroids, borate and silica gel dusts, and liquid nitrogen. For the liquid and dust insecticides to be effective, they must be touched or ingested by termites. Best results are obtained by drilling into the termite galleries and injecting products directly. Liquid nitrogen is different from the other spot treatment methods in that its mode-of-action is thermal; it causes a sudden drop in temperature, which kills the termites. Laboratory studies have shown that 5 minutes at -5°F (-21°C) kills drywood termites.

Microwave devices are also available for drywood termite control. Microwaves kill termites by causing fluids inside their cells to increase in temperature, which destroys the cell membranes. Advantages of microwaves include relative portability of equipment; and a nonchemical nature. When using microwaves, however, detection accuracy is critical to success. Both microwaves or heat treatments may damage the surface or interior of wood boards, depending on the power of the device. As with heat treatments, it may be difficult to heat areas with heat sinks to high enough temperatures with microwaves for effective control. Microwave devices are limited to certain areas because it may be impossible to use the device in small spaces, behind cabinets, etc.

High voltage electricity, is another nonchemical option for controlling drywood termites. The device currently marketed uses high voltage (90,000 volts), but low current (< 0.5 amps). The advantage of electrocution is that the equipment is portable and no chemicals are used. The limitations include detection accuracy and access to the entire colony. If drill holes and copper wire are used to enhance the flow of current into wood, minor damage occurs to wall coverings, walls, and structural wood members.

Minor damage to the structure occurs from the holes drilled for spot treatments of chemicals and for liquid nitrogen insertion. For all spot treatments, it is critical that all infestations in a structure are detected so that they all receive treatment.

Wood replacement is another remedial treatment option. However, similar to the other spot treatments, its effectiveness is highly dependent on detection accuracy and extent and location of the infestation, and it may be expensive to accomplish.

There is little information on biological control of drywood termites. Biological control is the use of other life forms (e.g., insects, nematodes, or microbes) to control pest insects. Currently research and development of biological control agents is underway with the possibility of commercial products being available sometime in the future.

It is unclear how effective pressure-treated wood (chemically treated wood that is brown or green in color) will be for drywood termites.

Painting also affords protection. Double coats of paint increases protection and epoxy enamel paint appears to be the most effective protection against drywood termites.

Before Contracting for Services

There are other measures advertised for controlling drywood termites. Before contracting for services or purchasing control devices, thoroughly investigate the company and/or the product.

It is advisable to contact several local pest control companies and get estimates for their termite control services. Also ask what follow-up programs they have and what guaranties exist. Ask for client referrals and check the status of their business license and consumer complaints with the Arizona Structural Pest Control Commission (602) 255-3664.

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The following information is provided to help you choose a suitable termite treatment program.

Summary of Drywood Termite Control Options

Treatment	Efficacy	Considerations	Damage to Home
Fumigants*	>99%	Must vacate, expensive, extinguish pilot lights	Minor
Heat*	>95%	Must vacate, expensive, extinguish pilot lights, no chemicals used	Can be a problem for electronic equipment, toilets sealed using wax rings
Chemical treatment of wood post construction	Varies depending on chemical and application	Residual protection good but only in the specific areas treated	Some drilling may be required
Liquid nitrogen*	>90%	Benign material	Some drilling may be required
Biological control	Data required	No chemicals used	Unknown
Electrocution*	10 -99%	No chemicals used	More effective when more holes are drilled
Microwaves*	90%	No chemicals used	Possible heat damage
Physical barriers	Data required	No chemicals used	Pre-construction incorporation
Pressure-treated wood	Data required	Long-term protection	Pre-construction incorporation or can be used to replace damaged materials

*Efficacy data presented was taken from Lewis, V. R. & M. I. Haverty. 1996. Evaluation of six techniques for control of the western drywood termite (Isoptera: Kalotermitidae) in structures. Journal of Economic Entomology 89:922-934. The study was conducted on a simulation home (stucco and wood construction), with an attic and crawl space.