

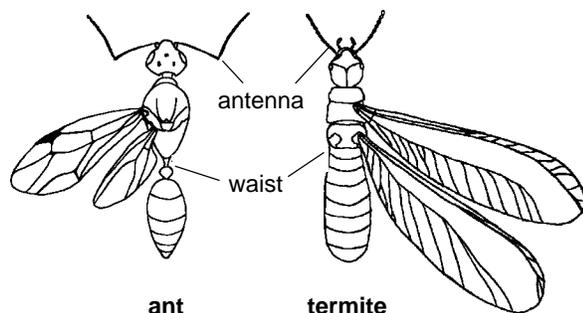
## Hawaii's Termites—An Identification Guide

Hawaii's year-round warm weather has allowed many introduced insect pests to take hold, and the seven species of termite found here are among these immigrants. The most destructive termites are the Formosan subterranean termite and the West Indian drywood termite, both of which arrived during the past 100 years and are now common throughout the state. They cause more than \$100 million damage per year to structures.

The other five termite species are not as great an economic threat. They are pests of trees and only occasionally infest structures. Three of them, the western drywood, Indo-Malaysian drywood, and Pacific dampwood termites, have arrived since the 1980s, and so far their distribution is not extensive. But because these recent introductions are significant pests elsewhere, they likely will become more economically important as they spread. The other two species, the forest and lowland tree termites, have probably been residents of Hawaii's forests for centuries.

The purpose of this publication is to help you identify Hawaii's termites. If you should find one of the known termite species in an unexpected place, or observe a termite that differs from the descriptions, it may be a new alien introduction. Please report such discoveries to your local office of the Cooperative Extension Service or the Hawaii Department of Agriculture.

### How to tell a winged ant from a termite



The winged forms of ants and termites are called "alates" or "swarmers" (shown here with half of each pair of wings removed). The ant's narrow waist and elbowed antenna distinguish it from the termite.

### Termite basics

Hawaii's termite species are all able to use wood as their food source with the help of microorganisms in their digestive systems. The Formosan subterranean termite lives primarily underground and moves up into structures or trees to feed. Drywood and dampwood termites live in wood at or above ground level.

Dampwood termites live in wet and rotting wood and get all of the water they need from their food. Drywood termites use water produced from the digestion of dry wood and do not require an external source of moisture. Subterranean termites live underground and obtain water from the soil around them, but they must venture out of this ideal environment to find food. To accomplish this, they build tube-like extensions to connect their moist underground environment to a potential food source, such as your home. These conduits are made of "carton material," a mixture of fecal matter and partially digested wood resembling mud, so they are commonly called "mud tubes." Subterranean termites occasionally form independent, aboveground colonies when their aboveground habitat provides them with a source of water—leaking roofs or plumbing fixtures are common water sources for such "aerial" colonies.

### Type of damage and other clues

Drywood termite colonies typically produce "kick-out holes" on the surface of the wood (Figure 1), from which they expel tiny fecal pellets (frass) that look like fine grains of sand (Figure 2). Sealed kick-out holes may indicate the presence of an active drywood termite infestation. Subterranean termites do not make kick-out holes in the wood. Their primary indicator is the presence of their "mud tubes" along boards, within wall voids, or bridging over masonry between the soil and the wooden parts of a structure (Figure 3).

The feeding patterns of the various types of termite also differ. Subterranean termites follow the grain, eating the softer areas along the length of the wood and

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Photographs by the authors and S. Halsted

leaving the harder grain skeleton. In contrast, drywood and dampwood termites eat across the grain in any direction (Figure 4).

### Economic importance

The most costly termite in Hawaii is the Formosan subterranean termite, followed by the West Indian drywood termite. The two forest-dwellers, the forest tree termite and the lowland tree termite, rarely infest structures. The damage potential of our three recent (1996–98) termite discoveries, the Indo-Malaysian drywood termite, western drywood termite, and Pacific dampwood termite, is as yet unknown.

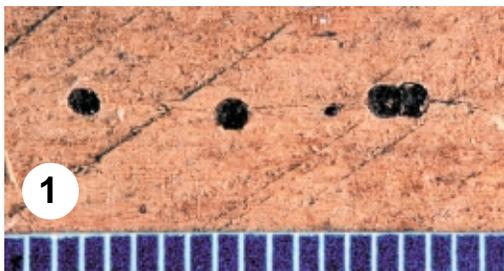
### New vs. “old”

The recently introduced termite species can be distinguished from Hawaii’s resident, established termites on close observation. The new Indo-Malaysian drywood termite is similar to the West Indian drywood termite, but it is smaller. The new western drywood termite swarmers (winged form, also called “alates”) have light-reddish-brown heads and black bodies (Figure 12), while the other drywood species are evenly colored. The Pacific dampwood termite is a very large termite with conspicuous projections on its abdomen called cerci (Figure 13).

## Wood damage and frass—signs of termite activity

### Drywood

Drywood termites make “kick-out holes” to remove fecal pellets (frass) from their “feeding galleries.” After pushing out the fecal pellets, they plug the holes.



Kick-out holes are about 1 mm ( $\frac{1}{25}$  of an inch) in diameter. Actual size = ●

The tiny fecal pellets of drywood termites may vary in color, even when coming from the same gallery.



Each mark on the scale is 1 mm ( $\frac{1}{25}$  of an inch). Actual size = ●●●

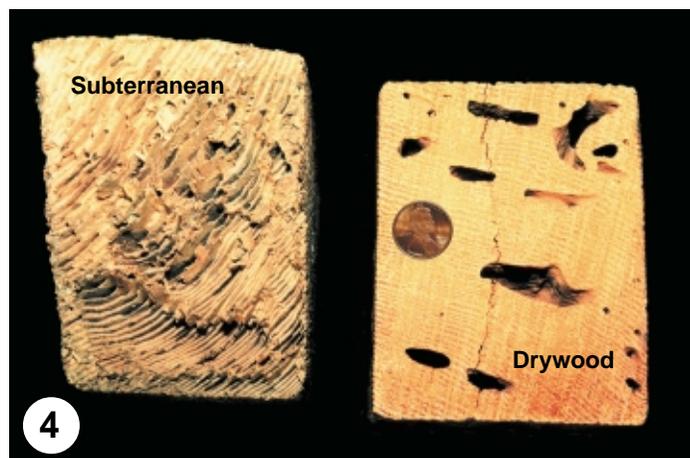
### Drywood vs. subterranean

Wood damage patterns are clues to termite type, as shown by these end-grain cross-sections of termite “feeding galleries.” Drywood termite galleries (right) are cavernous and do not follow any pattern or direction. Subterranean termite galleries (left) follow the grain of the wood, producing long hollowings of the softer part of the wood between the harder “rings” of wood.

### Subterranean



The “mud tube” along the side of this board is evidence of the presence of Formosan subterranean termites. Smaller patches of mud on the board’s corner and sides seal up openings made while feeding along the wood grain. The large tube is a major passageway to new feeding galleries further away from the underground nest.



## Identifying termites

The following “key” to termite species is designed to be used in two ways: either you have observed swarmer in the structure and you want to know what they are, or you have found damage in the structure and you want to know what caused it.

The key starts out by asking simple questions that help you determine if you are dealing with a subterranean termite. The next questions are more technical and will allow you to identify the species of termite. For this, you will need a ruler and a magnifying lens. You will also need to be able to recognize some of the different forms of termites that have different responsibilities within the colony: swarmer (alates), soldiers, and workers (Figure 11).

Before using the key, be sure that the insect is indeed a termite and not another type of insect. The insects most commonly confused with termite swarmer are the winged form of ants. Ant swarmer can readily be distinguished from termite swarmer based on the appearance of the antennae, wings, and waist (see p. 1). Other wood-destroying insects, such as some beetles, cause damage that may be confused with that of drywood termites, but these insects produce a fine sawdust material as opposed to the sand-like frass pellets of drywood termites (Figure 2).

Proceed from the key below to the species descriptions on p. 5. If the specimen that you have does not match the characteristics given, try keying again from the beginning with another specimen.

### Key for identifying termites—follow the steps for your situation

#### Condition: Swarming termites

- Step 1. If swarming is late in the day, in the evening, or at night, go to Step 3; if swarming is during the day, go to Step 2.
- Step 2. If the swarmer body is < 5 mm (about  $\frac{3}{16}$  inch) long, go to the description of the Indo-Malaysian drywood termite; if the swarmer is larger ( $> \frac{1}{4}$  inch), go to the description of the western drywood termite (p. 5).
- Step 3. If the swarm is small (< 200 swarmer) go to the next step; if the swarm is very large ( $> 1000$  swarmer), go to the description of the Formosan subterranean termite.
- Step 4. If the swarmer body is  $> 10$  mm ( $\frac{4}{10}$  inch), go to the next step; if the body is 10 mm or smaller, go to the description of the West Indian drywood termite.
- Step 5. If the swarm was in a dry site, generally below 500 ft, go to the description of the lowland tree termite; if the swarm was in a wet area, generally at higher elevations, go to the next step.
- Step 6. If the swarmer has conspicuous cerci (Fig. 13) and wings about 25 mm ( $\frac{7}{8}$ –1 inch) long, go to the description of the Pacific dampwood termite; if the swarmer is smaller, with wings 13–19 mm ( $\frac{1}{2}$ – $\frac{3}{4}$  inch) long, go to the description of the forest tree termite.

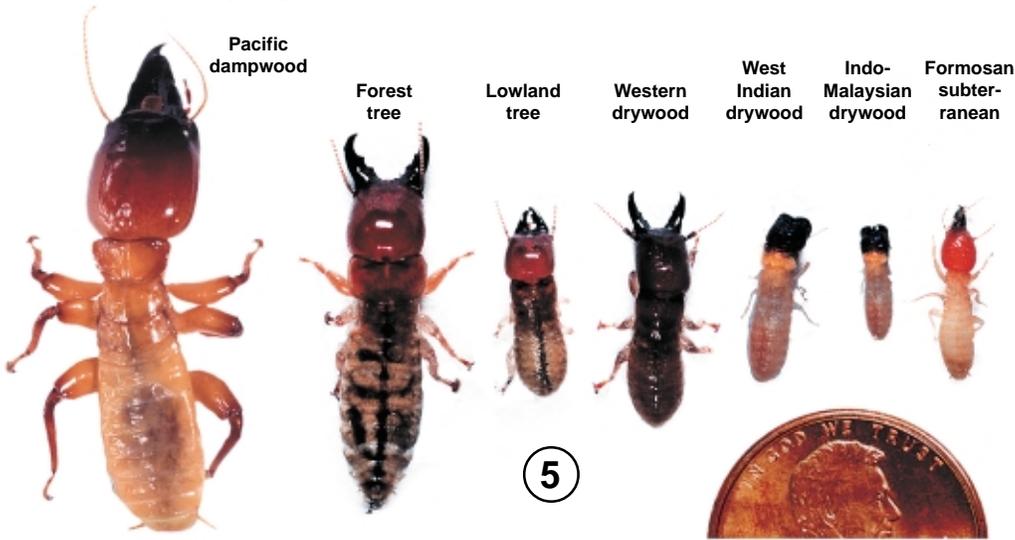
#### Condition: Termite damage found

- Step 1. If the voids left after the wood is eaten do not follow along the wood grain (within the growth rings) (see Fig. 4), go to the next step; if the feeding has followed the wood grain, leaving behind thin strips of the harder growth-ring wood (Fig. 4), go to the description of the Formosan subterranean termite.
- Step 2. If the wood contains dry, sand-like frass pellets, go to Step 3; if the damage does not contain sand-like frass or contains larger pellets that are sometimes clumped or wet, go to Step 6.

#### Now, for further identification, find termite soldiers.

- Step 3. If the face of the soldier appears pushed in, without distinctly protruding jaws (Fig. 9 or 10), go to Step 4; if the soldiers have obvious, protruding jaws (Fig. 6–8), go to Step 5, below.
- Step 4. If the soldier is < 5 mm (about  $\frac{3}{16}$  inch) long, go to the description of the Indo-Malaysian drywood termite; if the soldier is longer than 5 mm, go to the description of the West Indian drywood termite.
- Step 5. If the soldier is  $\frac{1}{2}$  inch or longer, go to Step 6. If the third segment (from the head) of the soldier’s antenna is distinctly longer than the other segments (Fig. 8), go to the description of the western drywood termite; if this segment is less than three times the length of any other segment in the antenna, go to the description of the lowland tree termite.
- Step 6. If the soldier is very large, up to 25 mm (1 inch) long, with conspicuous cerci (Fig. 13), go to the description of the Pacific dampwood termite. If the soldier is between  $\frac{1}{2}$  and  $\frac{3}{4}$  inch long with cerci that are barely visible, go to the description of the forest tree termite.

**The soldier caste** has features which, when observed close-up, can help to identify the termite species. Soldiers can be found in nests and galleries, protecting the smaller, more numerous workers and nymphs. Soldiers of Hawaii's termites vary in size from a body length of 3–4 mm (< 3/16 inch) to greater than 25 mm (> 1 inch).



The Formosan subterranean soldier has a tear-drop shaped head and sickle-shaped jaws.



**Formosan subterranean**

The lowland tree termite soldier's third antennal segment is about twice the length of the other segments; the third segment of the western drywood soldier's antenna is very large in comparison.



**Lowland tree**



**Western drywood**

**Other castes** in termite colonies have different forms and functions. The winged alate is the one we most often see, when they leave the colony to swarm and mate.



**Swarmer (alate) Nymph Soldier**

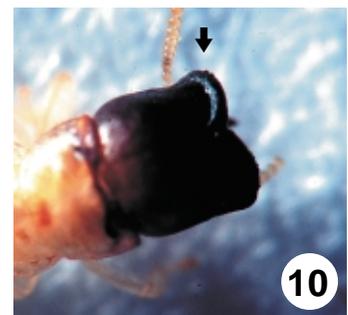
This western drywood termite swarmer (with wings removed to show the body) can be distinguished from the other species by its dark-colored body and reddish-brown head.



The heads of the West Indian and Indo-Malaysian termite soldiers appear pushed in and do not have prominent, protruding jaws. The West Indian termite's head is wrinkled, while the Indo-Malaysian termite's head is smooth. The distinct ridge on the front of the Indo-Malaysian termite's head (arrow) is another clue to its identity.



**West Indian**



**Indo-Malaysian**

## Seven termites currently found in Hawaii

### FORMOSAN SUBTERRANEAN TERMITE

(*Coptotermes formosanus*)

**Swarmers:** Body length about 10 mm (about  $\frac{3}{8}$  inch); light, reddish brown in color; two veins along the front margin of the wings; wings covered with extremely fine hairs; swarms during the evening. **Soldier:** Small; body length about  $\frac{1}{4}$  inch or less; mandibles sickle-shaped (Figure 6); aggressive and fast-moving.

### WEST INDIAN DRYWOOD TERMITE (*Cryptotermes brevis*)

**Swarmers:** Body length about 6 mm ( $\frac{1}{4}$  inch) or greater; head width greater than 1 mm; swarms at night. **Soldier:** Body length 5 mm or slightly more; width of head capsule greater than 1 mm; head is rough and wrinkled in appearance without a distinct frontal ridge (Figure 9).

### LOWLAND TREE TERMITE (*Incisitermes immigrans*)

**Swarmers:** Body length 10 mm ( $\frac{4}{10}$  inch); light to dark brown; wing has three veins along the front margin. **Soldier:** Third antennal segment about two times the length of succeeding segments (Figure 7); lives in living or dead dry wood; found predominantly along coast; will infest structures in rare instances.

### FOREST TREE TERMITE (*Neotermes connexus*)

**Swarmers:** Body length 15 mm ( $\frac{1}{2}$ – $\frac{5}{8}$  inch) or more; wing has four large veins at the front margin. **Soldier:** Body length 10–20 mm ( $\frac{3}{8}$ – $\frac{3}{4}$  inch); lives in dead, wet wood or living trees; generally found above 500 ft elevation; usually does not infest structures.

### INDO-MALAYSIAN DRYWOOD TERMITE

(*Cryptotermes cynocephalus*)

**Swarmers:** Body length (minus wings) not greater than 5 mm ( $\frac{3}{16}$  inch); head less than 1 mm wide; swarms in the morning. **Soldier:** Body length 3–4 mm ( $< \frac{3}{16}$  inch) or less; width of head capsule approx. 1 mm; head has a distinct ridge running along the front margin (Figure 10).

### WESTERN DRYWOOD TERMITE (*Incisitermes minor*)

**Swarmers:** Body dark brown or black with a distinctly reddish-brown head (Figure 12); swarms during daylight hours. **Soldier:** Third antennal segment very long, three times the length of succeeding antennal segments (Figure 8); can be found infesting trees as well as structures; a rare termite in Hawaii; more likely to be found at lower elevations ( $< 500$  ft).

### PACIFIC DAMPWOOD TERMITE (*Zootermopsis angusticollis*)

**Swarmers:** The largest swarmer in Hawaii; light cinnamon brown with dark brown, leathery wings 22–25 mm ( $\frac{7}{8}$ –1 inch) long. Each antenna has at least 23 segments, and the abdomen has distinct cerci. **Soldier:** The largest termite found in Hawaii; body 10–25 mm ( $\frac{3}{8}$ –1 inch) long, with light caramel-brown thorax and abdomen. The head is more flattened than that of a drywood termite soldier and has a formidable set of toothed jaws (Figure 5). Lives in wet or decayed wood.

## Wings are another clue . . .

The wings of termite swarmers are convenient identification aids when viewed with a magnifying lens. The two veins along the top of the wing of the Formosan subterranean termite are parallel to each other. The corresponding veins of the drywood and dampwood termites are more complex.



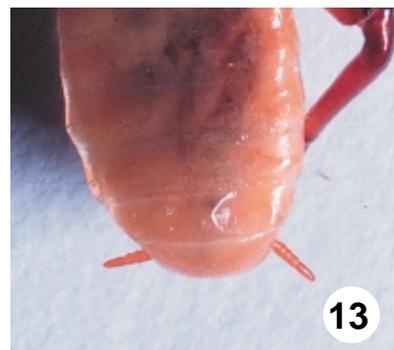
Formosan subterranean termite wing



Drywood or dampwood termite wing (generalized)

## . . . and so are cerci

In addition to its large size, the Pacific dampwood termite has appendages (cerci) on its abdomen that are much more prominent than those of the drywood termites.



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### Comparison of Hawaii's termite species

Species	Type (subterranean drywood, or dampwood)	Habitat (structures or trees)	Climate (wet or dry)	Swarming time	Evidence	Occurrence in Hawaii
Formosan subterranean <i>Coptotermes formosanus</i>	sub	both	both	night	mud tubes	statewide
West Indian drywood <i>Cryptotermes brevis</i>	dry	structures	both	night	dry frass	statewide
Indo-Malaysian drywood <i>Cryptotermes cynocephalus</i>	dry	both	both	dawn–day	dry frass	Oahu
Lowland tree <i>Incisitermes immigrans</i>	dry	trees	dry	night	dry frass	statewide
Western drywood <i>Incisitermes minor</i>	dry	both	dry	day	dry frass	Oahu
Forest tree <i>Neotermes connexus</i>	dry	trees	wet	night	wet frass	statewide
Pacific dampwood <i>Zootermopsis angusticollis</i>	damp	both	wet	dusk–night	wet frass	Maui

### Termite control

Many innovations in termite control methods have been developed recently, but the fundamental strategy to avoid costly termite damage is preventive management through regular, professional inspections. Potential structural damage can be avoided by using treated wood or steel framing. Preventive management for subterranean termites should also include either physical or chemical barriers (or both) where the structure meets the soil. Preventive management for drywood termites includes maintaining screens to exclude swarms and keeping exposed wood surfaces painted.

When termites are found within a building, the various options for remedial control vary with termite type

(drywood or subterranean). Drywood termites can be controlled with spot treatments, which can be cost-effective if the damage is fairly localized. If the damage is extensive, whole-structure fumigation (“tenting”) may be required to effectively combat the infestation. Remedial control of subterranean termite infestations frequently involves creating chemical or physical barriers where the structure meets the soil. This excludes further access, but spot treatment of the structure with insecticides sometimes is required to kill termites remaining in it. Termite baiting is a recent technology that can both monitor and control subterranean termites.

### And Hawaii's next termite introduction will be . . . ?

One possibility is a subterranean termite established in Guam (*Coptotermes vastator*). It has been reported once in Hawaii, but so far there have been no reports of it establishing a population here. This termite is similar to the Formosan subterranean termite, but its swarms are generally dark on the upper surface and reddish brown underneath, while the Formosan subterranean termite swarms are a uniform light reddish brown. Any termite that does not match the photographs or descriptions given here may be a new introduction and should be reported immediately to the nearest office of the Hawaii Department of Agriculture or the Cooperative Extension Service.