EXTENSION PUBLICATIONS

UNIVERSITY of HAWAI'I at MĀNOA
COLLEGE OF TROPICAL AGRICULTURE AND HUMAN RESILIENCE

Keys for Distinguishing Eight Termite Species in Hawai‘i

Figure 1. Drywood termites in Hawai‘i. Photo: Jia-Wei Tay.

At a Glance: With the recent establishment of the Asian subterranean termite, *Coptotermes gestroi* (Wasmann), on the island of O‘ahu, eight termite species are now present in Hawai‘i. Correct identification of termite species is needed to better predict their behavior, manage their populations, and limit the damage they cause each year to Hawai‘i structures and trees. This publication updates and replaces the Woodrow et al. (1999) termite identification key published by UHM CTAHR (now the College of Tropical Agriculture and Human Resilience, University of Hawai‘i at Mānoa).

Introduction to Hawai‘i's Termites

Hawai‘i's subtropical climate, interisland transport network, and continual influx of global commerce have created ideal conditions for the establishment and spread of termites. These factors, combined with urban expansion and the widespread use of wood-based construction, have made termite management a growing challenge in the islands. Collectively, subterranean and drywood (Figure 1) termites are estimated to cause over $100 million in annual damage to structures and trees in Hawai‘i (Grace 2010).

Since the last termite identification guide for Hawai‘i was published in 1999 (Woodrow et al. 1999), the number of known termite species in the state has increased from seven to eight (Grace 2010). Notably, the Asian subterranean termite, *Coptotermes gestroi* (Wasmann), has emerged as a new pest. Initially confined to lands southwest of Pearl Harbor (Woodrow et al. 2001), *C. gestroi* is now well established across much of the western half of O‘ahu, ranging from the south shore to the northernmost beaches (Tong and Tay 2025). Compared to Hawai‘i's long-time resident subterranean termite, *C. formosanus* Shiraki, *C. gestroi* occurs in warmer and drier areas on O‘ahu and exhibits greater tolerance to drought and heat (Grace

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2014), traits that may facilitate its continued expansion amid global climate change. Alongside the changes in termite species composition in Hawai‘i, the broader scientific classification of termites has also evolved: in 2018, termites were reclassified from the order Isoptera to Blattodea (Harrison et al. 2018).

Understanding the biology and behavior of termite species is crucial for their effective management. For example, most indoor treatments, such as enhanced heat treatments or fumigation, are most effective against drywood termites that nest within wood (Tay and James 2021). In contrast, subterranean termites like *C. formosanus* and *C. gestroi* mostly live in underground colonies and forage into structures. Treatments targeting the structure alone often fail to eliminate reproductive individuals among subterranean termites. Furthermore, *C. formosanus* and *C. gestroi* exhibit different tunneling behaviors that have implications for the effectiveness of traditional in-ground termite bait stations, highlighting the importance of accurate identification when developing pest control strategies.

Given these biological and behavioral distinctions, accurate identification becomes critical not only for effective management but also for rapid detection of and response to newly introduced invasive species or potential hybrid termite species (Chouvenc et al. 2025; Tong and Tay 2025). Careful inspection of materials, especially wood products, is a crucial step to prevent termites from hitchhiking and spreading to new areas. Finally, public awareness is a key part of long-term control efforts. Residents should not assume all termites are the same. Educational outreach to help members of the public recognize the differences among species can lead to more effective reporting, response, and management.

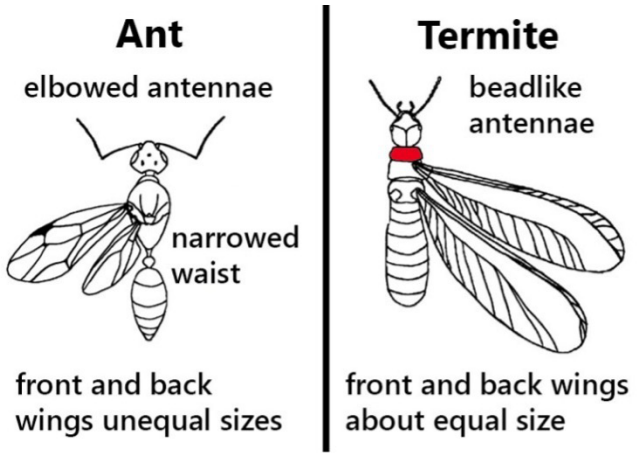

Figure 2. A comparison of flying ants (left) and termite alates (right), highlighting distinctive anatomical features that can be seen with the naked eye. In termites, differences in the first segment of the thorax, or pronotum (highlighted in red), are among the traits commonly used to identify termite species. Diagram modified from Woodrow et al. 2000.

As social insects, termite colonies consist of castes, that is, groups of individuals with specific functions that have distinct physical forms. Although the life cycles of Hawai‘i's termite species vary, all eight species include a reproductive caste, a soldier caste, and an immature caste of workers or false workers that is the most numerous caste in a colony. As they have not reached a final molt, immatures appear soft-bodied and whitish; they usually have no eyes or are in the early stages of eye development.

The reproductive caste has wings and distinct eyes, and are referred to as alates, after *ala*, the Latin word for wing. Reproductives from a mature colony exit their natal (birth) nest by flying (swarming) and are attracted to light. Upon finding a suitable mate and nesting place, reproductives shed their wings and are then known as dealates. The reproductive caste is more sclerotized (hardened), and therefore darker than immatures. They are often mistaken for winged ants (Figure 2). Termite alates have bead-like antennae, no narrowed “waist,” and four wings of about equal size and shape, while winged ants have elbowed antennae, a narrowed waist, and four wings with the front wings larger than the back wings. Soldiers have a whitish body and sclerotized head. Among the species present in Hawai‘i, subterranean termite colonies have a higher percentage of soldiers than drywood termite colonies.

How to Use the Termite Keys

This updated identification tool, illustrated with labeled photographs, is designed to help users identify all the termite species currently confirmed in Hawai‘i. The eight species of termites can be identified based on the anatomical characteristics of the soldiers (Key S) that defend colonies and the winged reproductive swarmers, called alates (Key A), that establish new colonies. By highlighting the visible differences that distinguish each termite species, these identification keys can significantly enhance the accuracy of termite identification efforts.

When possible, the identification keys have been based on characters (traits) that can be used even when termites are desiccated (dried out) or discolored. To use the key, begin with its first step, compare the step’s two options (A and B), and choose the option that matches the termite being examined. Follow the instructions at the end of the chosen option to reach the next step, until the termite species has been identified.

Key S: How to Identify the Termite Soldiers of Hawai'i

Step S.1

A. The head is plug-like and appears pushed in (Figure 3A), with mandibles (jaws) that are small when viewed from above [Kalotermitidae: *Cryptotermes*]. **Go to Step S.2**

B. The head does not appear pushed in, and the mandibles are easily visible from above (Figure 3B). **Go to Step S.3**

Figure 3. Top views of termite soldiers. **3A:** Plug-like, pushed-in head shape with no visible mandibles (arrow). **3B:** Oval and square head shapes, not pushed in, with easily visible mandibles (labeled). Scale bar is 1 mm. Photos: Reina Tong

Step S.2

A. The head is wrinkled (Figure 4A) with no distinct ridge at its front edge (Figure 4A). The head is usually more than 1 mm wide (Figure 4B, face view). ***Cryptotermes brevis***

B. The head is smoother, with a distinct ridge at its front edge (Figure 5A, 5B). The head is usually less than 1 mm wide (Figure 5C, face view). ***Cryptotermes cynocephalus***

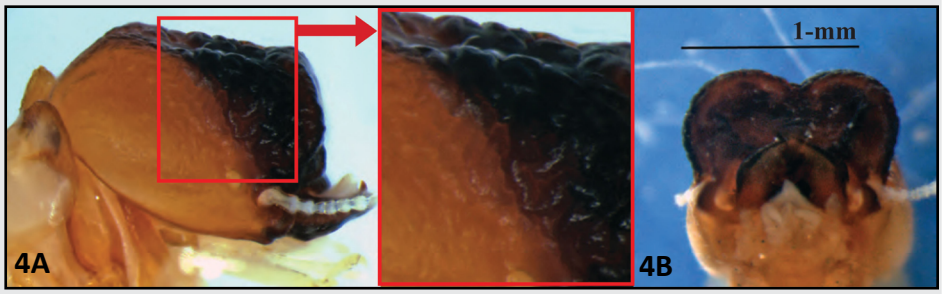

Figure 4. A *Cryptotermes brevis* soldier. **4A, with inset**: The wrinkled head has no distinct ridge at the front edge. **4B**: The head is more than 1 mm wide in face view. Photos: Reina Tong

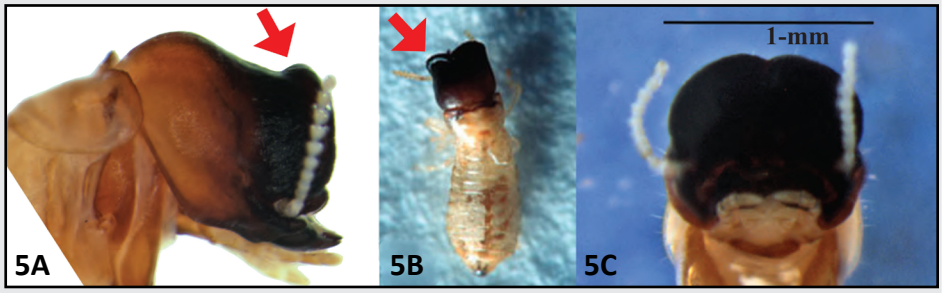

Figure 5. A *Cryptotermes cynocephalus* soldier. **5A,B**: The head is smoother, with a distinct ridge at the front edge (arrows). **5C**: The head is less than 1 mm wide in face view. Photos 5A and 5C: Reina Tong; photo 5B: from Woodward et al. 1999

Key S: How to Identify the Termite Soldiers of Hawai‘i, cont.

Step S.3

A. The head is orange, oval-shaped when viewed from above (Figure 6A), with smooth, black, sickle-shaped mandibles (Figure 6A). A fontanelle (frontal pore; see arrow) is present (Figure 6B) [Heterotermitidae: *Coptotermes*].
Go to Step S.4

B. The head is orange, rectangular when viewed from above (Figure 6C), often dark brown near the mandibles, with the mandibles serrated and dark (Figure 6D). No fontanelle is present.
Go to Step S.5

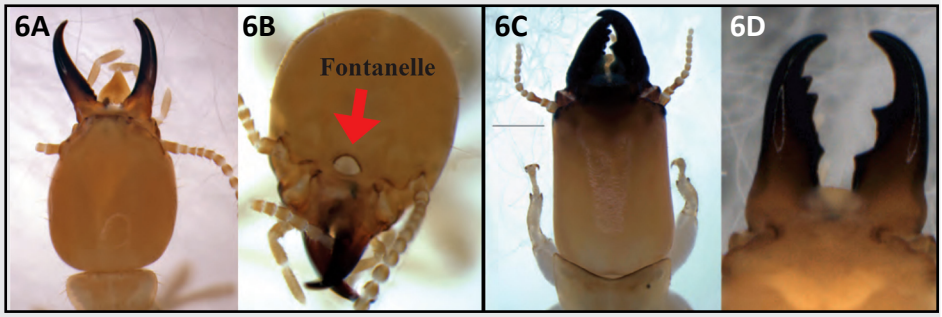

Figure 6. Termites with mandibles that are prominent in top view. **6A:** An orange, oval-shaped head with black, sickle-shaped mandibles. **6B:** The fontanelle (frontal pore) is labeled. **6C:** A rectangular head. **6D:** Serrated, dark mandibles. Scale bar is 1 mm. Photos: Reina Tong

Step S.4

A. Four hairs are present at the opening of the fontanelle (Figure 7A). No slight bump is visible at the front of the head in profile view (Figure 7B). ***Coptotermes formosanus***

B. [Note: The specimen in Figure 8B is faded.] Two hairs are present at the opening of the fontanelle (Figure 8A). A slight bump is visible at the front of the head in the profile view (Figure 8B). ***Coptotermes gestroi***

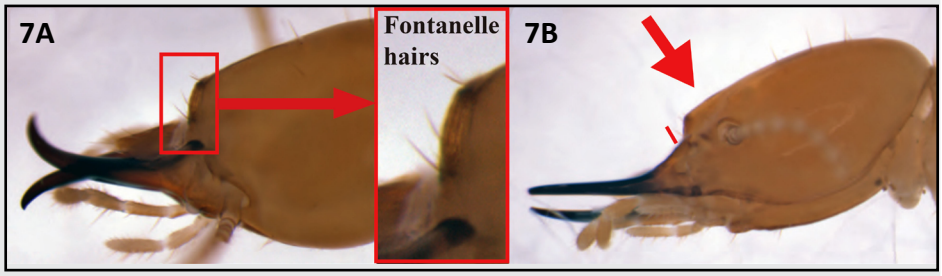

Figure 7. A *Coptotermes formosanus* soldier. **7A, with inset**: Note four fontanelle hairs (labeled). **7B:** At the front of the head in profile view (arrow), no slight bump is visible. Note the red line is shorter than in Figure 8B. Photos: Reina Tong

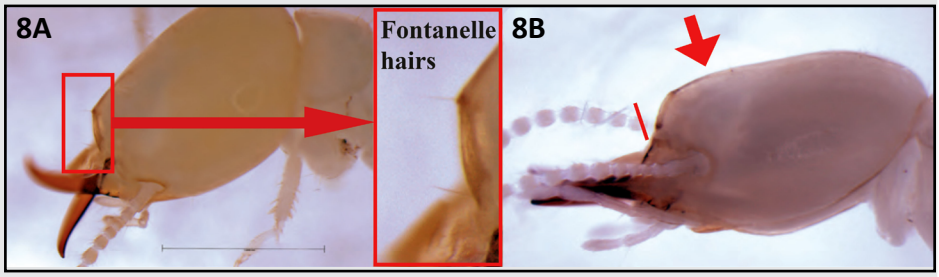

Figure 8. A *Coptotermes gestroi* soldier. **8A, with inset:** Note two labeled hairs at the opening of the fontanelle. **8B:** (Specimen is faded.) At the front of the head in profile view (arrow), a slight, visible bump is highlighted by the red line, which is longer than in Figure 7B. Scale bar is 1 mm. Photos: Reina Tong

Key S: How to Identify the Termite Soldiers of Hawai'i, cont.

Step S.5

A. The pronotum (first thoracic segment; see Figure 2) is narrower than the head (Figure 9A). Sclerotized spines are present on the shaft of the tibia (Figure 9B). The cerci (paired appendages at the end of the abdomen) are long, that is, more than three segments each (Figure 9B). ***Zootermopsis angusticollis***

B. The pronotum is wider or nearly as wide as the head (not shown here; see Figures 11A, 12A, and 13A). Hairs may be present on the tibial shaft, but sclerotized tibial spines are not present (Figure 10). Tibial spurs (downward-facing spines on the tip of tibia) are present (Figure 10). The cerci are short, less than three segments each. **Go to Step S.6**

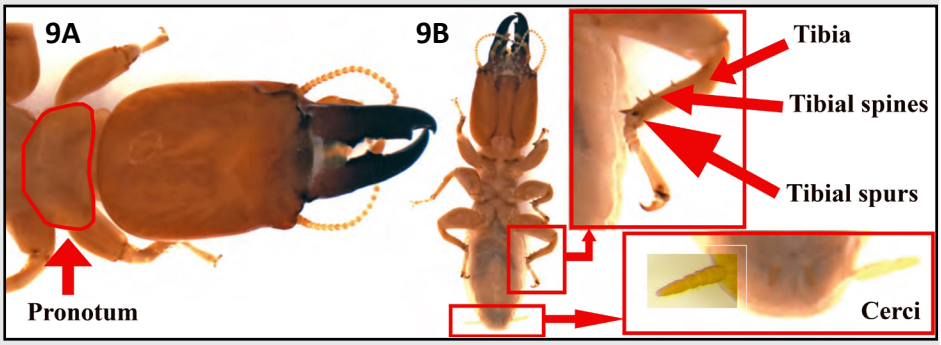

Figure 9. A *Zootermopsis angusticollis* soldier. **9A:** Pronotum is narrower than head. **9B, with insets:** Tibial spines (labeled) are present. The cerci (labeled) have more than three segments (see box for detailed view). Tibial spurs (see also Figure 10) are labeled to distinguish them from tibial spines. Photos: Reina Tong

Figure 10. Spines are absent along the length of the tibia (top arrow). Downward-facing spines at the tip of the tibia, called tibial spurs (bottom arrow), are present. Photo: Reina Tong

Step S.6

A. Top margin of the pronotum is more "C"-shaped, and third antennal segment is shorter than fourth and fifth segments combined (Figure 11A). Eyes are dark and conspicuous (Figure 11B). The gula (throat) on the ventral side of the head narrows greatly at its center to less than half the width of its top portion near the mandibles (Figure 11C; each of the three red lines represents the gula's narrowest width). ***Neotermes connexus***

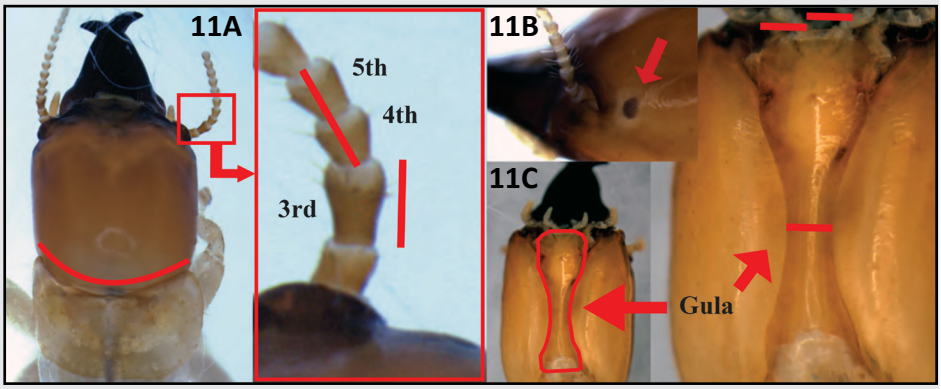

Figure 11. A *Neotermes connexus* soldier. **11A, with inset:** The pronotum's front margin is C-shaped (red line). The 3rd antennal segment is shorter than the 4th and 5th segments combined (compare red lines). **11B:** The eye (arrow) is black and conspicuous. **11C, with inset:** At its center (arrow points to red line), the outlined and labeled gula (throat) narrows greatly to less than half its width near the mandibles (two red lines). Photos: Reina Tong

Key S: How to Identify the Termite Soldiers of Hawai‘i, cont.

Step S.6, cont.

B. The pronotum is more “V”-shaped at its top margin (Figures 12A and 13A). The third antennal segment is equal to or longer than the fourth and fifth segments combined (Figures 12B and 13B) [Kalotermitidae: *Incisitermes*].
Go to Step S.7

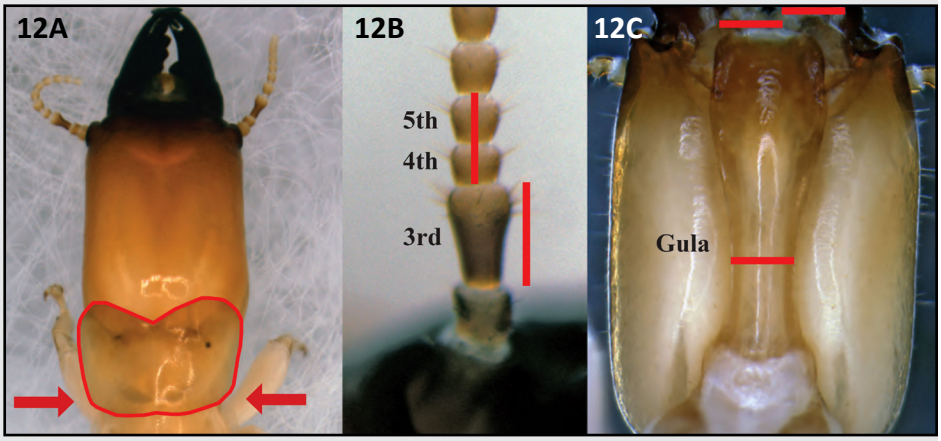

Figure 12. An *Incisitermes immigrans* soldier. **12A:** The margins at the top and bottom (arrows) of the V-shaped pronotum (outlined) are about equal. **12B:** The 3rd antennal segment is equal to or longer than the 4th and 5th segments combined, but not more than the 4th, 5th, and 6th segments combined (compare red lines). **12C:** At its most narrow (red line), the gula is more than half its width at the top margin (two red lines). Photos: Reina Tong

Step S.7

A. The top and bottom margins of the pronotum are about equal in width (Figure 12A). The third antennal segment is equally long or longer than the fourth and fifth segments combined, but not longer than the fourth, fifth, and sixth segments combined (Figure 12B). The center of the gula is less narrowed, being more than half as wide as the top portion near the mandibles (Figure 12C; each of the three red lines represents the gula’s narrowest width). ***Incisitermes immigrans***

B. [Note: The specimens in Figure 13A and 13B are faded.] The pronotum's top margin is much wider than its bottom margin (Figure 13A). The third antennal segment is about equal to the fourth, fifth, and sixth segments combined (Figure 13B). The gula is narrowed in the center, about half as wide as the top portion near the mandibles (Figure 13C; each of the three red lines represents the gula’s narrowest width). ***Incisitermes minor***

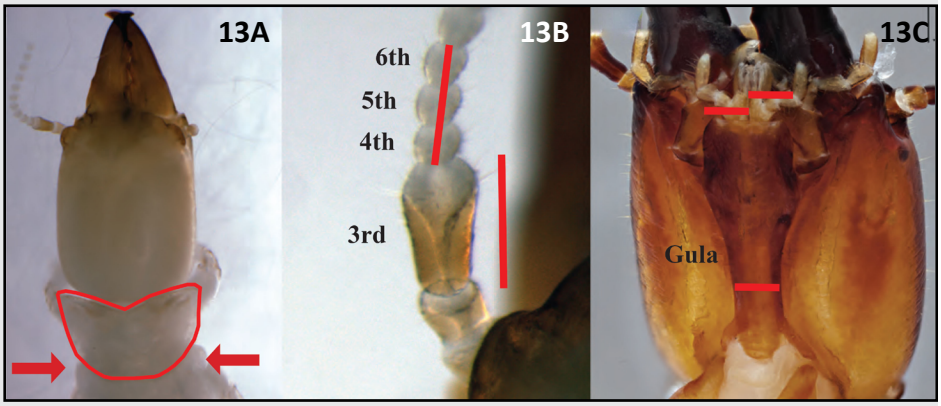

Figure 13. An *Incisitermes minor* soldier. **13A:** The bottom margin (arrows) of the V-shaped pronotum (outlined) is narrower than the top margin. **13B:** The 3rd antennal segment is equal to 4th, 5th, and 6th segments combined (compare red lines). **13C:** At its most narrow (red line), the gula is about half its width at the top margin (two red lines). Photos 13A and 13B: Reina Tong; photo 13C: Ed Freytag

Key A: How to Identify the Termite Alates of Hawai'i

Step A.1

A. The wings have only two heavily sclerotized (thickened) veins (Figure 14A), with no cross veins (see Figure 14D for comparison). Minute hairs cover the wings (Figure 14B). A fontanelle (pore) is present on the head (Figure 14C) [Heterotermitidae: *Coptotermes*]. **Go to Step A.2**

B. The wings have three or more heavily sclerotized veins with cross veins (Figure 14D). The wings are not covered with minute hairs (not shown). A fontanelle is absent (not shown) [Archotermopsidae, Kalotermitidae]. **Go to Step A.3**

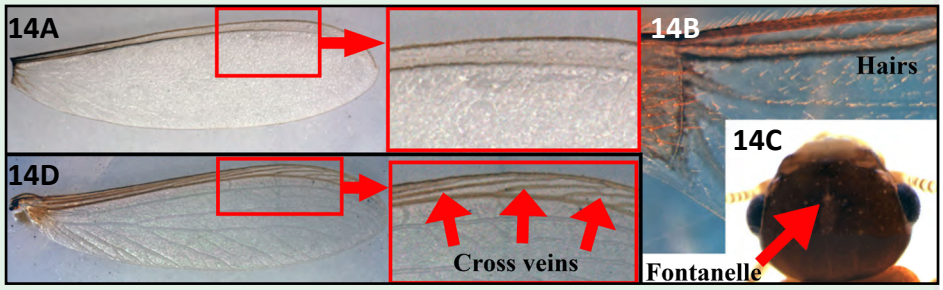

Figure 14. Traits that differentiate Hawai'i's subterranean and drywood termite alates. **14A, with inset:** The wings of Hawai'i's subterranean termite do not have cross veins. **14B:** Minute hairs cover a subterranean termite wing. **14C:** A fontanelle (pore; see label and arrow) on the head of a subterranean termite alate. **14D, with inset:** Cross veins (labeled, arrows) on the wing of a drywood termite. Photos: Reina Tong

Step A.2

A. The termite's total length, including wings, is about 14 mm. The head is light yellow-brown and the antennal spots (located near the ocelli, or simple eyes) are not prominent or crescent-shaped (Figure 15A). The maximum head width is ~1.5 mm. The wing length is usually over 11 mm, and a faint yellow costal band is present near the radial sector towards the tip of the wing (Figure 15B). ***Coptotermes formosanus***

B. The termite's total length, including wings, is less than 12 mm. The head is dark brown, and crescent-shaped antennal spots are prominent near the ocelli (Figure 16A). The maximum head width is less than 1.4 mm. The wing length is less than 10 mm (usually 9 mm), and no costal band is present (Figure 16B). ***Coptotermes gestroi***

Figure 15. A *Coptotermes formosanus* alate. **15A:** No prominent crescent-shaped antennal spot is present near the ocellus (simple eye; arrow and label). **15B:** The alate wing in this photo shows a faint yellow costal band (arrow and label). Photos: Reina Tong

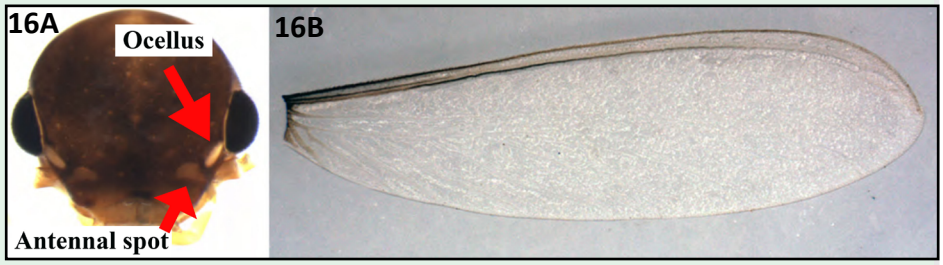

Figure 16. A *Coptotermes gestroi* alate. **16A:** A prominent, crescent-shaped antennal spot (arrow and label) is present near the ocellus (simple eye; arrow and label). **16B:** The alate wing does not show a costal band. Photos: Reina Tong

Key A: How to Identify the Termite Alates of Hawai‘i, cont.

Step A.3

A. Ocelli (simple eyes) are absent (Figure 17A). The cerci are prominent, with more than three segments (Figure 17B). The wings are leathery and about 18 mm in length. There are one or more spines on the shaft of the tibia, and tibial spurs also present (Figure 17C) [Archotermopsidae]. ***Zootermopsis angusticollis***

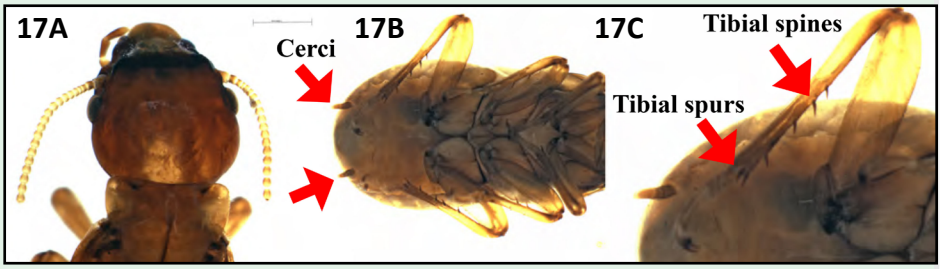

Figure 17. A *Zootermopsis angusticollis* alate. **17A:** No ocelli (simple eyes) are present. **17B:** The cerci (labeled, arrows) are long, more than three segments. **17C:** Both tibial spines (labeled, arrow) and tibial spurs (labeled, arrow) are present. Scale bars are 1 mm. Photos: Reina Tong

B. Ocelli are present (Figure 18A). The wings are not leathery and are less than 18 mm in length (not shown). No sclerotized spines are present on the shaft of the tibia, although hairs may be present. Tibial spurs are present (Figure 18B) [Kalotermitidae].
Go to Step A.4

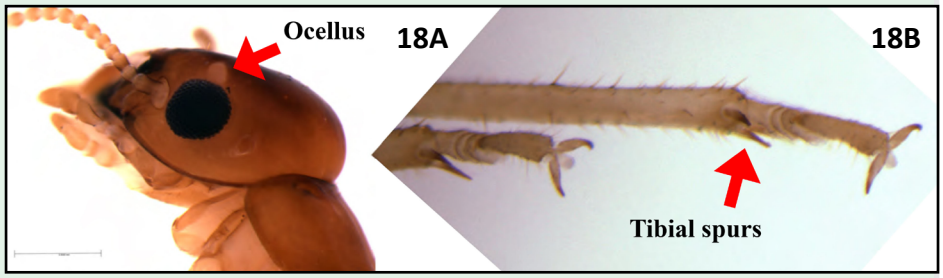

Figure 18. A termite alate with ocelli (simple eyes). **18A:** Ocelli are present; in this side view, a single ocellus (arrow) is labeled. **18B:** Tibial spines are absent, although hairs may be present (compare to Figure 17C). Tibial spurs (arrow, labeled) are present. Scale bars are 1 mm. Photos: Reina Tong

Step A.4

A. The total body length with wings is 16 to 18 mm (not shown), and the width of the pronotum is about 2 mm (Figure 19A). The wing length is greater than 12 mm. The median vein is as heavily sclerotized as the radial sector and parallels the radial sector closely (Figure 19B). Arolium (pad between the tarsal claws) present (Figure 19C). ***Neotermes connexus***

B. The total body length with wings is less than 16 mm. The wing length is less than 12 mm. The median vein is weak (not sclerotized). **Go to A.5**

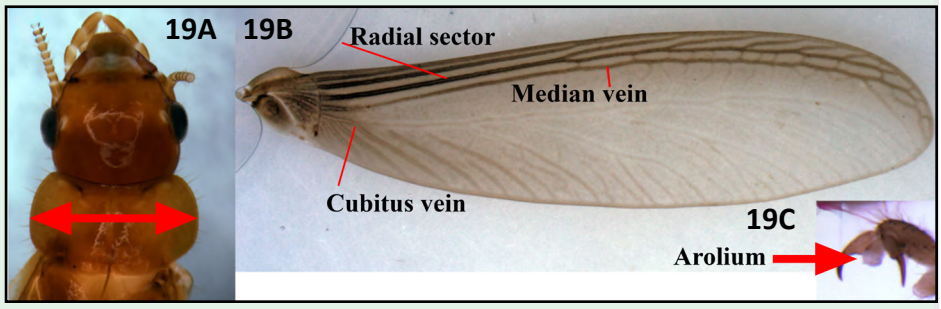

Figure 19. A *Neotermes connexus* alate. **19A:** The head and pronotum (double-headed arrow) are shown. **19B:** The radial sector (labeled) and median vein (labeled) are heavily sclerotized, but the cubitus vein (labeled) is not heavily sclerotized. The median vein closely parallels the radial sector. **19C:** Arolium present between the tarsal claws. Photos: Reina Tong

Key A: How to Identify the Termite Alates of Hawai'i, cont.

Step A.5

A. The median vein reaches the apex (tip) of the wing (Figure 20A). Head length from the back of the head to the tip of the labrum is greater than 1.3 mm (Figure 20B). [*Incisitermes*]. **Go to Step A.6**

B. The median vein generally does not reach the apex of the wing and often bends upward toward the radial sector (Figure 20C). Head length to the tip of the labrum is less than 1.3 mm (Figure 20D) [*Cryptotermes*]. **Go to Step A.7**

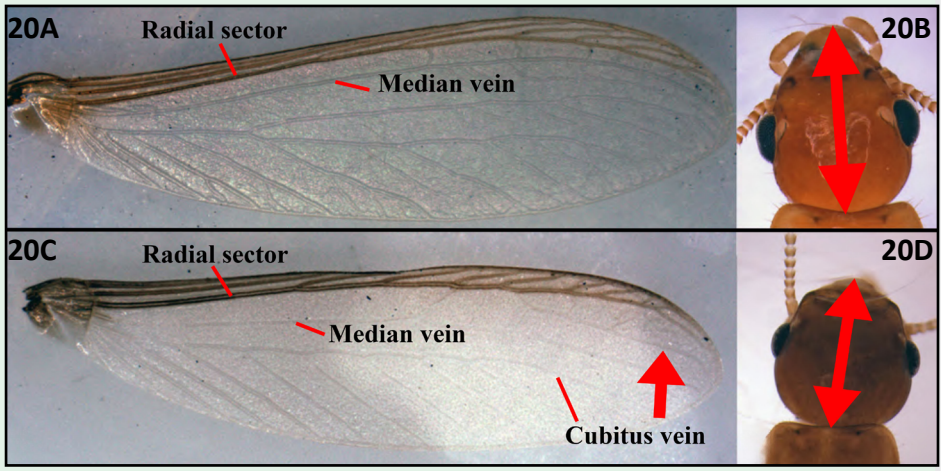

Figure 20. Traits that differentiate *Incisitermes* alates from *Cryptotermes* alates in Hawai'i. **20A:** The median vein extends from base to tip of wing. **20B:** Head is longer than 1.3 mm (see doubled-headed arrow from the back of the head to the tip of the labrum). **20C:** The median vein does not extend to the tip of the wing. Note the cubitus vein (labeled; also marked by arrow) extends to tip of wing). **20D:** Head is shorter than 1.3 mm (see doubled-headed arrow from the back of the head to the tip of the labrum). Photos: Reina Tong

Step A.6

A. [Note: The specimen in Figure 21 is faded.] The head is reddish-brown, and the body is bluish-black. Each eye is positioned a length roughly equal to its diameter from the bottom margin of head (Figure 21A) and about three times its diameter from the back margin of the head (Figure 21A and 21B). The wings are smoky gray with black veins and 8 to 9 mm long. Arolium absent (Figure 21C). ***Incisitermes minor***

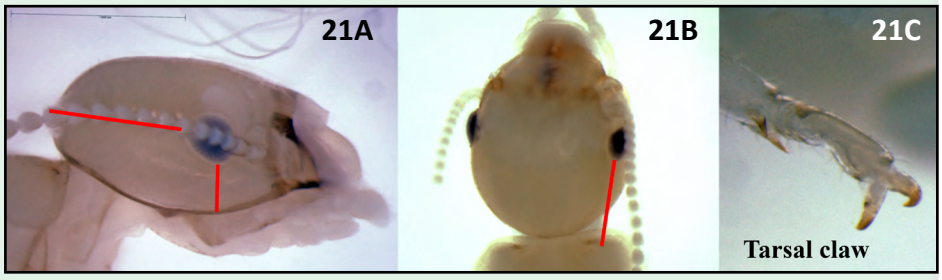

Figure 21. An *Incisitermes minor* alate. **21A:** The eye is shown in its position relative to the bottom of the head (vertical red line, about equal to the eye's diameter) and the back of the head (horozontal red line, about three times the eye's diameter). **21B:** Eye size relative to position from the back of the head (horizontal red line, about three times the eye's diameter). **21C:** Arolium absent between the tarsal claws (labeled). Scale bars are 1 mm. Photos: Reina Tong

Key A: How to Identify the Termite Alates of Hawai‘i, cont.

Step A.6, cont.

B. The head is yellow-brown to chestnut, and the body is pale yellow. Each eye is separated by a length less than its diameter from the bottom margin of the head (Figure 22A). The wings are yellow to light brown and 10 mm long (Figure 22B). Arolium present (Figure 22C). ***Incisitermes immigrans***

Figure 22. An *Incisitermes immigrans* alate. **22A:** The eye is shown in its position relative to the bottom of the head (red line shorter than the eye's diameter) and the back of the head (longer red line). **22B:** A yellow-brown wing with scale bar. **22C:** Arolium (labeled) present between the tarsal claws. Scale bars are 1 mm. Photos: Reina Tong

Step A.7

A. The total body length with wings is 10 to 12 mm (not shown), and the wing length is 8 to 9 mm (Figure 23A). The wings are prismatic when dry (not captured in Figure 23). The median vein usually bends forward to join the radial sector, and the cubitus vein joins the radial sector in the distal third of wing (Figure 23A). Arolium absent (Figure 23B). The maximum head width slightly exceeds 1 mm, and the head length is 1 to 1.2 mm, with a Y-shaped epicranial suture usually visible (Figure 23C). A pale, T-shaped mark is often present on the pronotum (Figure 23D). ***Cryptotermes brevis***

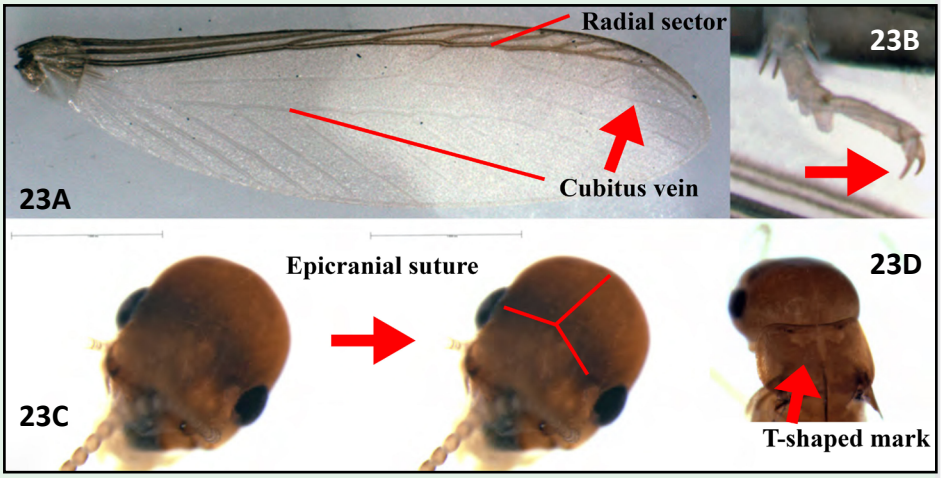

Figure 23. A *Cryptotermes brevis* alate. **23A:** A wing in which the cubitus vein (labeled, red line) joins the radial sector in the distal third (red arrow). **23B:** No arolium is present between the tarsal claws (red arrow). **23C:** A Y-shaped epicranial suture often present on head (note head size). **23D:** A T-shaped mark is present on the pronotum. Scale bars are 1 mm. Photos: Reina Tong

B. [Note: The specimen in Figure 24A is slightly faded; the wings are typically dark]. The wing length is about 5.5 mm long (Figure 24A). The median vein bends forward to join the radial sector (Figure 24A, not labeled). The total body length with wings is 6 mm, and body length without wings less than 5 mm (Figure 24B). The maximum head width is less than 1 mm, and maximum head length is less than 1 mm (0.76–0.85 mm) (Figure 24B). Arolium present (not shown). ***Cryptotermes cynocephalus***

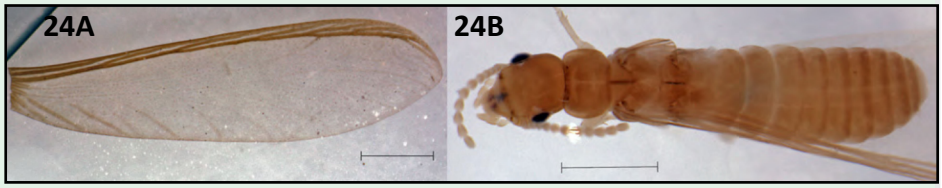

Figure 24. A *Cryptotermes cynocephalus* alate. **24A:** A wing with scale bar. **24B:** A body with one wing and scale bars. Scale bars are 1 mm. Photos: Reina Tong

Concluding Remarks

The composition of Hawai'i's termite fauna will continue to evolve as global trade, climate change, and interisland movement create new introduction pathways and alter habitat suitability. Surveillance, coupled with the use of identification tools such as these keys, is essential for limiting future economic and ecological damage. A recent study by Chouvenc et al. (2025) confirmed the first field-documented hybridization between *C. formosanus* and *C. gestroi* populations in Florida, raising concerns that similar interspecies breeding could occur in Hawai'i where both species also coexist. Individuals encountering specimens that do not clearly match the provided key descriptions or that appear in unexpected locations are encouraged to contact the Hawai'i Department of Agriculture for further assistance. Continued collaboration among researchers, pest management professionals, and the public is the best defense against the next unwanted invasive species arrival.

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