By: Dr. J. Kenneth Grace

Aloha Termites — Pests in Paradise

Located in the center of the Pacific Ocean, the state of Hawaii consists of eight principal islands, with a population of 1.3 million people. Seventy percent of Hawaii's population (about 900,000 people) live on the capital island of Oahu, known to visitors for the city of Honolulu and attractions such as Diamond Head, Pearl Harbor, and Waikiki — the vacation spot of kings, and now the destination of the greatest number of tourists to the Aloha state.

With a steady stream of cargo, military traffic, and visitors coming to appreciate Hawaii's moderate tropical climate, many unwanted visitors such as insects, the coqui frog, and fast-growing weeds also have found their way to the islands. For that reason, agricultural inspections are in effect both entering and leaving the state; and these quarantine measures have been effective in preventing migration of more unwanted visitors such as snakes (we have none!) to Hawaii. They've also helped prevent pests, such as fruit flies, from traveling from Hawaii to the continental USA (called the "mainland" by Hawaii residents).

A cluster of termites. *Copyright © 2000, University of Hawaii Termite Project/Photo Dr. R. Joseph Woodrow*

AN ONGOING BATTLE. The State of Hawaii Department of Agriculture estimates that about 15 new insects are introduced to the state each year. For more than 100 years, state entomologists and pest management specialists have relied on biological control (the introduction of beneficial insects to prey on pests) as the primary method of bringing most of these pests of agriculture, natural resources, and ornamental plants under control. Although we do have a few beneficial wasps that attack cockroaches on the islands, in large part biological control has been much less successful in managing structural pests such as cockroaches, ants and termites. With warm temperatures year round, and a constant influx of new insect visitors, Hawaii's pest management industry truly has its work cut out for it!

Ants. About 50 introduced ant species now call Hawaii home, including common pests such as the Argentine ant, big-headed ant, glaber (or black) ant, Pharaoh ant, and ghost ant. In mid-2010, the odorous house ant (*see related story on page 22*) was found for the first time on the island of Maui. Although the red imported fire ant has not yet made its way across the Pacific, Hawaii is home to the related tropical fire ant, and also the little fire ant — currently found only on the island of Hawaii (called the "Big Island" by locals), and in one location on the island of Kauai. The Hawaiian carpenter ant is the largest ant on the islands. Although it does little actual damage to wood, it loves to nest in hollow spaces, and startles homeowners with its nightly foraging activities.

Cockroaches. About 20 cockroaches have also found their way to Hawaii's welcoming shores, including the German, American, and (equally large) Australian cockroach. The Asian cockroach is often mistaken for a German cockroach, but usually lives outside and is capable of sustained flight. The Surinam cockroach is thought to have been the first cockroach introduced to Hawaii, and is unique in being one of the only cockroaches to regularly host a disease agent — eyeworm of poultry, a serious problem in chickens. The jewel-like harlequin cockroach also lives outside in Hawaii, and is thought to have been spread around the world by Spanish galleons. Interestingly, the Oriental cockroach is about the only universal pest species not (yet) found in Hawaii, probably because it favors cooler climates.

TERMITES. When it comes to termites, Hawaii is known worldwide as home to the notorious Formosan subterranean termite (FST), and also as a center of research on termite biology and management. The FST was probably introduced to Hawaii by boats from southern China at the end of the sandalwood trade in the early 1860s. It was first recognized in Hawaii and described by an entomologist shortly after the turn of the 20th century, and has been estimated to cost residents of Hawaii more than $100 million each year. During the last half of the 20th century, the FST has spread throughout the subtropical regions of the world, as is all too apparent to residents of the Gulf coast.

Hawaii is also home to two drywood termite species that live largely outside in fallen wood, or dead limbs on trees — the large forest tree termite (*Neotermes connexus*) and the lowland tree termite (*Incisitermes immigrans*). The lowland tree termite is interesting since it is a close relative of the western drywood termite found infesting numerous structures in California, but has only rarely been found in buildings in Hawaii. Both of these termite species probably came to Hawaii before man, perhaps on logs floating in the sea.

The worst drywood termite pest in Hawaii is the West Indian drywood termite (*Cryptotermes brevis*), also sometimes called the powderpost drywood termite in some parts of the U.S. This termite almost exclusively infests seasoned wood, and probably came to Hawaii with early Polynesian settlers, although transport on later ships is also possible.

During the past 15 years, the number of termite pests found in Hawaii has literally doubled from the four previously discussed. We now have eight termite species established in Hawaii, although the four newcomers (or "malihini") are still very limited in their distribution on the islands in comparison to the original termite residents (or "kamaaina" termites). These four recent immigrants include the Pacific dampwood termite (*Zootermopsis angusticolis*), the western drywood termite, the Indo-Malaysian drywood termite (*Cryptotermes cynocephalus*), and the Asian subterranean termite (*Coptotermes gestroi*).

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The Pacific dampwood termite is only found at higher elevations on Maui at this point, and was apparently imported in logs used by a local resident to make Hawaii's unique musical instrument, the ukulele (or "jumping flea"). The western drywood and Indo-Malaysian drywood termites are also very limited in their distribution — both are found only on Oahu, and only in a few locations so far. Both of these are severe structural pests in other parts of the world, however, so it's likely that they will gradually expand on the island.

The final recent discovery in Hawaii has been the Asian subterranean termite (AST), which is found in Southeast Asia, the Philippines (where it was thought until recently to be an island native), Guam, Taiwan, the Caribbean, and southern Florida. Although the AST was first found in Hawaii in 1963, in a house near the Manoa campus of the University of Hawaii on Oahu, it was never found again until the late 1990s, when it appeared in military housing (and nearby civilian houses and trees) and buildings on the leeward

(Above photo) Termite soliders with "personality." *Copyright © 2000, University of Hawaii Termite Project/Photo Dr. R. Joseph Woodrow*

(Bottom photo) An up-close view of a termite queen. *Copyright © 2000, University of Hawaii Termite Project*

(western) side of Pearl Harbor. Since that discovery, AST has continued to slowly spread into surrounding housing areas. Given that this termite is ubiquitous in both the Philippines and Guam, it can be expected to continue to spread on Oahu, and eventually to the neighboring islands.

OUR RESEARCH. Research at the University of Hawaii (UH) has found some unique differences between the Formosan and Asian subterranean termites. Among other differences, the AST is less aggressive than the FST, dries out more quickly (which might explain why it is usually found closer to the equator than the FST), eats a bit slower, and exhibits very different tunneling patterns in the soil. While the FST tends to dig rather large, straight tunnels while searching for food, the AST has a finer and multi-branched network of tunnels, similar in appearance to a mosaic or jigsaw puzzle. Despite these differences, both termites are voracious pests, and double-trouble for Hawaii!

Many of the methods used to control drywood and subterranean termites in Hawaii have grown out of research at the University of Hawaii. Hawaii is unique among the states in requiring that all structural wood in buildings be either from a naturally durable timber, or treated with a wood preservative to prevent decay and termite attack. Based on UH research, borates are the most popular wood preservatives in use. Steel framing and plastic fencing have replaced a lot of the wood used in building construction as well.

In addition to baits and soil termiticides (tested by UH since the 1950s), physical barriers to termite penetration are quite popular in Hawaii. The Basaltic Termite Barrier (BTB) was developed by Emeritus Professor Minoru Tamashiro, and is often used in new building construction in a layer beneath the concrete foundation slab — first in state government construction, and now in many residential homes. This crushed basalt (volcanic rock) is screened to a particle size that is too large for termites to grasp in their mandibles and move, and packs too well for them to find air-spaces to move through. So long as it is not disturbed, it forms a permanent, physical barrier to invading termites. Innovative pest management firms have added additional protection in the form of perimeter termiticide treatments.

Termimesh, a stainless steel wire mesh barrier to termites is also used extensively in construction throughout Hawaii. Electrical utilities place a "sock" of Termimesh over the butt-end of poles before placing them in the ground.

Currently, staff at the University of Hawaii are engaged in a large-scale program to teach the next generation of homeowners how to prevent termite damage, and at the same time increase the science literacy of our public school students. This school curriculum project, tied to termite management seminars for local residents as well, has been developed in cooperation with the USDA Agricultural Research Service, and has touched thousands of island residents. "Educate to Eradicate" is the theme of this research and outreach effort.

Both the termite researchers at the University of Hawaii, and Hawaii's dynamic pest management industry want to welcome NPMA and its members to Hawaii with a big "Aloha!"

A termite soldier up close.

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INVASIVE **ANTS**

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the same time, by reporting any new or unusual species, PCOs become an invaluable first line of defense in protecting Hawaii's residents, agricultural producers, natural environment and economy. And when it comes to ants, there are several good online resources to help PCOs determine which species they're dealing with. These include a pictorial identification guide to the ants of Hawaii (http://pick4.pick.uga.edu/mp/20q?guide=Ants_Hawaii), a website providing a species list and high quality images of the ants of Hawaii (http://www.antweb.org/hawaii.jsp), and a key to invasive ants of the Pacific (http://keys.lucidcentral.org/keys/v3/PIAkey/index.html; which includes many of the species found in Hawaii, plus others not yet found in the state). A number of agencies or entities can be contacted to report new or questionable species, foremost the Hawaii Department of Agriculture, but also the Invasive Species Committees of Hawaii, or specialists at the University of Hawaii. Finally, while the impacts of invasive pest species may be particularly acute in Hawaii, the best practices touched on above pertain to PCOs everywhere. Superior taxonomic skills, a high degree of vigilance and diligent reporting result in a win-win situation for everyone.

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