

OPERATION FULL STOP



**Update 2001:
Termites, We've Got You Numbered!**

Summer, 2001
Vol. 3, No. 1

This featured article, by researchers from Hawaii and North Carolina, describes how tracking the genetic links between Formosan Subterranean Termites is helping scientists to understand how termite colonies spread and are organized. Already, scientists have determined that humans do more to spread Formosan Termites than the species themselves. Furthermore, knowledge of colony organization (e.g. the number of kings and queens) is important because in order for baits to be effective they must infiltrate the complex spatial and social organization of colonies. The information provided by genetic studies of Formosan termites will unlock the secrets to controlling this pesky pest.

Guest Column

What can molecular biology tell us about termites?

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There is no need in the southeastern United States and the State of Hawaii to emphasize the need for better management of the Formosan Subterranean Termite. Improving termite management requires a thorough understanding of the biology of this termite species, though.

For example, when a new termite infestation is found, the most important questions are: Where do those termites come from, how can we prevent their further spread, and how can we get rid of them most efficiently?

To identify sources of introduction and to limit termite expansion we first need to track the most probable routes of spread. Subsequently these routes can be targeted by regulatory efforts, such as increased quarantine measures and inspections.

To use baiting systems most effectively for control in areas where termite colonies are established, it is helpful to know if all the infestations in a given area belong to the same colony and are interconnected. To improve such baiting systems, it is necessary to find out if there are any social or spatial structures within termite colonies that might impede distribution of the bait toxin through the whole colony.

Lastly, if termites reinfest a location after baits have been used to eliminate the activity, we would like to know which colony they came from.

A challenge to researchers has always been that subterranean termites live a cryptic life underground, which makes it difficult to spy on their biology. Fortunately, the genetic material of termites, DNA, can tell much of the story of their history and lifestyle, if one can read the messages.

Termite DNA is passed from generation to generation following the same rules as human genetics, and each termite gets half of its DNA from the father and half from the mother. Thus, DNA contains information about ancestry as well as about relationships among individuals.

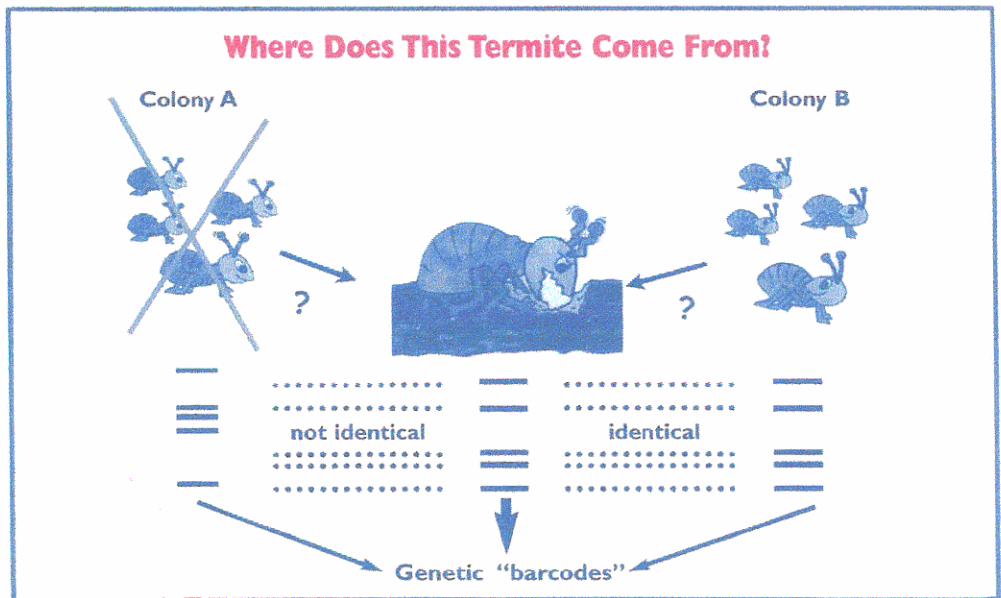
Molecular genetic techniques used in termite research involve enzymatic digestion of DNA, separation of the DNA fragments through gel electrophoresis, and hybridization with labeled probes, as well as gene sequencing or amplification of certain regions of the DNA through polymerase chain reaction (PCR). These methods yield distinct banding patterns, which reflect the identity of termites and a large part of their biological features. Basically, termites come with individual "barcodes" just like canned goods in

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the supermarket, and these molecular genetic techniques make the codes visible. These "codes" or — in more scientific terms — "genotypes" are unique to each individual termite, and also indicate their membership in a particular colony (family) and regional population.

Comparing genotypes, and calculating their frequencies, distributions and genetic similarities within and among colonies or populations reveals important information about termite biology.

For example, comparing genetic similarities between termite colonies to geographical distances tells how termites spread throughout a region. Termites are weak flyers, therefore colonies close to each other should be more closely related to each other than to colonies from distant locations.

However, we did not find such a relationship between geographic and genetic distance among *Coptotermes formosanus* (Formosan Subterranean Termite) colonies on the island of Oahu, Hawaii. This provides evidence that the Formosan Subterranean Termite covers large distances with human help, i.e. hitchhiking in wooden materials.

We are now following this approach on a global scale to shed light on the sources, methods and speed of Formosan Subterranean Termite dispersal around the world.

On a smaller scale we use the individual-specific and colony-specific genotypes ("barcodes") to assign termites to their home colonies and to "tag" colonies prior to elimination by baiting so that we can study subsequent termite re-invasion (see figure).

Comparing the genotypes of colonies tells us if reappearing termites are remnants of the same colony or invaders from adjacent colonies.

The frequencies of genotypes among the offspring (workers and soldiers) of a colony reveal the number of kings and queens that are actively reproducing in the colony, and can almost never be counted directly. The relatedness among the offspring tells us whether a colony is headed by unrelated kings and queens (the colony founders) or by related, inbred reproductives (replacement reproductives).

The presence of multiple kings and queens located in different parts of the colony could lead to spatial stratification, or separate groupings of more closely related individuals, within colonies as has been shown in other termite species. This is important to investigate in *C. formosanus*, since it could influence the spread of bait toxicants through the colony.

In conclusion, understanding the genetic structure of termite populations and colonies sheds light on invasion and dispersal of termites on both global and local scales. In addition, molecular techniques help to identify and characterize colonies, as well as define the colonies' social and spatial structure. All this information is extremely valuable to help improve regulatory and remedial termite control measures.

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