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How to Reign Indefinitely

New Ideas / by Sheila Prakash / April 8, 2009

An unusual form of **asexual reproduction** by a Japanese species of termite begs the question: **What is the value of sex?**

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Queen Succession Through Asexual Reproduction in Termites
Science March 27, 2009

Despite their reputations as home-devouring pests, termites exhibit one of the most distinguished social hierarchies in the insect world. And this hierarchy continues to get more and more perplexing.

Entomologists from North Carolina State University and Okayama University in Japan have recently discovered that the primary queen in colonies of *Reticulitermes speratus* does not lay eggs through sexual reproduction in order to select her successor, as expected. Instead, she bears her own offspring in an asexual process called parthenogenesis, ensuring that 100 percent of her genes are passed on. This is the first observation in nature of parthenogenesis in termites.

"This whole thing suggests the larger question of why there is sex," says Edward Vargo, an associate professor of entomology at NCSU who helped conduct the study.

"Most insect species reproduce sexually, but when you think about it, there are a lot of costs associated with sex," says Vargo. Specifically, in termite hierarchies, the king dilutes the strength of queen's genes through incest with her daughters. "A female who reproduces asexually can pass on all of her genes to each of her offspring. So she has twice the reproductive success of an individual who reproduces sexually."

The upside to sexual reproduction is the genetic diversity it promotes. In most termite colonies, the king continues to mate with the queen's daughters after the original queen has died. This inbreeding results in a loss of genetic diversity that significantly hampers a colony's fitness and adaptability. *R. speratus* has avoided this situation entirely by incorporating both sexual and asexual reproduction into its life cycle. Inbreeding does not occur because, technically, the king is mating with the original queen again and again. By avoiding incest altogether, the genetic diversity of the colony is preserved. "Here we have a very unique system where you get the best of both worlds," says Vargo.


The primary king and queen start the colony after their mating flight. Credit: Kenji Matsuura

In colonies of *R. speratus*, the primary queen asexually produces her replacement, something called the "secondary reproductive," or the secondary queen. A single colony can have dozens of secondary queens. (One of the colonies studied had 135.) Although these secondary queens carry 100 percent of the primary queen's genes (and are fully capable of reproducing themselves), they are stunted and lack fully developed wings — a crucial and distinguishing feature that can help scientists genetically trace why, for example, some offspring become workers and some don't.

"One of the problems we've had with termites is that you can't predict them," says Vargo. "You can't look at an individual and know if it's going to develop into a queen or if it's going to develop into a worker."

Now we can. Although they look different (and inbreed to produce more offspring), the genome of the secondary queen is completely known. In addition to making some termites easier to identify, this could lead to discovering whether there is a link between genes and caste determination.

"I think this changes our idea of the breeding structure of termite colonies," says Vargo. "And it shows us that there can be unexpected breeding structures that we won't know of until we actually go out and investigate them."

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