

Taxonomy and Evolution of Termites

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Short Communication

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DESCRIPTION

Termites are a group of detritophagous eusocial insects which consume a wide variety of decaying plant material, generally in the form of wood, leaf litter, and soil humus. They are distinguished by their moniliform antennae and the soft-bodied and typically unpigmented worker caste for which they have been colloquially termed "white ants"; however, they are not ants to which they are distantly related. About 2,972 extant species are currently described, 2,105 of which are members of the family Termitidae.

Termites were formerly placed in the order Isoptera. As early as 1934 suggestions were made that they were closely related to wood-eating cockroaches (genus *Cryptocercus*, the woodroach) based on the similarity of their symbiotic gut flagellates. In the 1960s additional evidence supporting that hypothesis emerged when F. A. McKittrick noted similar morphological characteristics between some termites and *Cryptocercus* nymphs. In 2008 DNA analysis from 16S rRNA sequences supported the position of termites being nested within the evolutionary tree containing the order Blattodea, which included the cockroaches.

The cockroach genus *Cryptocercus* shares the strongest phylogenetical similarity with termites and is considered to be a sister-group to termites. Termites and *Cryptocercus* share similar morphological and social features: for example, most cockroaches do not exhibit social characteristics, but *Cryptocercus* takes care of its young and exhibits other social behaviour such as trophallaxis and allogrooming. Termites are thought to be the descendants of the genus *Cryptocercus*. Some researchers have suggested a more conservative measure of retaining the termites as the Termitoidea, an epifamily within the cockroach order, which preserves the classification of termites at family level and below.

Termites have long been accepted to be closely related to cockroaches and mantids, and they are classified in the same superorder (Dictyoptera). The oldest unambiguous termite fossils date to the early Cretaceous, but given the diversity of Cretaceous termites and early fossil records showing mutualism between microorganisms and these insects, they possibly originated earlier in the Jurassic or Triassic. Possible evidence of a Jurassic origin is the assumption that the extinct mammalia form *Fruitafossor* from Morrison Formation consumed termites, judging from its morphological similarity to modern termite-eating mammals.

Morrison Formation also yields social insect nest fossils close to that of termites. The oldest termite nest discovered is believed to be from the Upper Cretaceous in West Texas, where the oldest known faecal pellets were also discovered. Claims that termites emerged earlier have faced controversy. For example, F. M. Weesner indicated that the Mastotermitidae termites may go back to the Late Permian, 251 million years ago, and fossil wings that have a close resemblance to the wings of *Mastotermes* of the Mastotermitidae, the most primitive living termite, have been discovered in the Permian layers in Kansas. It is even possible that the first termites emerged during the Carboniferous. The folded wings of the fossil wood roach *Pycnoblattina*, arranged in a convex pattern between segments 1a and 2a, resemble those seen in *Mastotermes*, the only living insect with the same pattern, consider that all of the Paleozoic and Triassic insects tentatively classified as termites are in fact unrelated to termites and should be excluded from the Isoptera. Other studies suggest that the origin of termites is more recent, having diverged from *Cryptocercus* sometime during the Early Cretaceous.

The primitive giant northern termite (*Mastotermes darwiniensis*) exhibits numerous cockroach-like characteristics that are not shared with other termites, such as laying its eggs in rafts and having anal lobes on the wings. It has been proposed that the Isoptera and Cryptocercidae be grouped in the clade "Xylophagodea". Termites are sometimes called "white ants", but the only resemblance to the ants is due to their sociality which is due to convergent evolution with termites being the first social insects to evolve a caste system more than 100 million years ago. Termite genomes are generally relatively large compared to those of other insects; the first fully sequenced termite genome, of *Zootermopsis nevadensis*, which was published in the journal *Nature Communications*, consists of roughly 500Mb, while two subsequently published genomes, *Macrotermes natalensis* and *Cryptotermes secundus*, are considerably larger at around 1.3Gb.

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