

# Termite – college essay



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Termites are a group of eusocial insects that, until recently, were classified at the taxonomic rank of order Isoptera (see taxonomy below), but are now accepted as the epifamily Termitoidae, of the cockroach order Blattodea.

While termites are commonly known, especially in Australia, as “white ants,” they are only distantly related to the ants. Like ants, some bees, and wasps—which are all placed in the separate order Hymenoptera—termites divide labour among castes, produce overlapping generations and take care of young collectively.

Termites mostly feed on dead plant material, generally in the form of wood, leaf litter, soil, or animal dung, and about 10 percent of the estimated 4,000 species (about 2,600 taxonomically known) are economically significant as pests that can cause serious structural damage to buildings, crops or plantation forests. Termites are major detritivores, particularly in the subtropical and tropical regions, and their recycling of wood and other plant matter is of considerable ecological importance.

As eusocial insects, termites live in colonies that, at maturity, number from several hundred to several million individuals. Colonies use decentralised, self-organised systems of activity guided by swarm intelligence which exploit food sources and environments unavailable to any single insect acting alone. A typical colony contains nymphs (semi-mature young), workers, soldiers, and reproductive individuals of both genders, sometimes containing several egg-laying queens.

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Social organization[edit] Reproductives

This fertile termite queen (*Coptotermes formosanus*), is showing its ovary-filled, distended abdomen. The rest of its body is the same size as that of a worker. A female that has flown, mated, and is producing eggs is called a “queen.” Similarly, a male that has flown, mated, and is in proximity to a queen is termed a “king.” Research using genetic techniques to determine relatedness of colony members has shown the original idea that colonies are only ever headed by a monogamous royal pair is wrong. Multiple pairs of reproductives within a colony are commonly encountered.

In the families Rhinotermitidae and Termitidae, and possibly others, sperm competition does not seem to occur (male genitalia are very simple and the sperm are anucleate), suggesting only one male (king) generally mates within the colony. At maturity, a primary queen has a great capacity to lay eggs. In physogastric species, the queen adds an extra set of ovaries with each molt, resulting in a greatly distended abdomen and increased fecundity, often reported to reach a production of more than 2, 000 eggs a day. The distended abdomen increases the queen’s body length to several times more than before mating and reduces her ability to move freely, though attendant workers provide assistance. The queen is widely believed to be a primary source of pheromones useful in colony integration, and these are thought to be spread through shared feeding (trophallaxis). The king grows only slightly larger after initial mating and continues to mate with the queen

for life (a termite queen can live for 45 years). This is very different from ant colonies, in which a queen mates once with the male(s) and stores the gametes for life, as the male ants die shortly after mating.

Two termites in the process of shedding their wings after mating, Maun, BotswanaThe winged (or "alate") caste, also referred to as the reproductive caste, are generally the only termites with well-developed eyes, although workers of some harvesting species do have well-developed compound eyes, and, in other species, soldiers with eyes occasionally appear. Termites on the path to becoming alates (going through incomplete metamorphosis) form a subcaste in certain species of termites, functioning as workers ("pseudergates") and also as potential supplementary reproductives.

Supplementaries have the ability to replace a dead primary reproductive and, at least in some species, several are recruited once a primary queen is lost. In areas with a distinct dry season, the alates leave the nest in large swarms after the first soaking rain of the rainy season. In other regions, flights may occur throughout the year, or more commonly, in the spring and autumn. Termites are relatively poor fliers and are readily blown downwind in wind speeds of less than 2 km/h, shedding their wings soon after landing at an acceptable site, where they mate and attempt to form a nest in damp timber or earth. edit] Workers Worker termiteWorker termites undertake the labors of foraging, food storage, brood and nest maintenance, and some defense duties in certain species. Workers are the main caste in the colony for the digestion of cellulose in food and are the most likely to be found in infested wood. This is achieved in one of two ways. In all termite families except the Termitidae, flagellate protists in the gut assist in cellulose

digestion. citation needed] However, in the Termitidae, which account for approximately 60% of all termite species, the flagellates have been lost and this digestive role is taken up, in part, by a consortium of prokaryotic organisms. This simple story, which has been in entomology textbooks for decades, is complicated by the finding that all studied termites can produce their own cellulase enzymes, and therefore might digest wood in the absence of their symbiotic microbes, although new evidence suggests these gut microbes make use of termite-produced cellulase enzymes. citation needed][1] Our knowledge of the relationships between the microbial and termite parts of their digestion is still rudimentary. What is true in all termite species, however, is the workers feed the other members of the colony with substances derived from the digestion of plant material, either from the mouth or anus. This process of feeding of one colony member by another is known as trophallaxis, and is one of the keys to the success of the group.

It frees the parents from feeding all but the first generation of offspring, allowing for the group to grow much larger and ensuring the necessary gut symbionts are transferred from one generation to another. Some termite species do not have a true worker caste, instead relying on nymphs that perform the same work without differentiating as a separate caste. [citation needed] [edit] Soldiers A picture of a soldier termite (Macrotermitinae) with an enlarged jaw in the Okavango Delta. The soldier caste has anatomical and behavioural specializations, providing strength and armour which are primarily useful against ant attack.

The proportion of soldiers within a colony varies both within and among species. Many soldiers have jaws so enlarged that they cannot feed

themselves, but instead, like juveniles, are fed by workers. The pantropical subfamily Nasutitermitinae have soldiers with the ability to exude noxious liquids through either a horn-like nozzle (nasus). Simple holes in the forehead called "fontanelles" and which exude defensive secretions are a feature of the family Rhinotermitidae. Many species are readily identified using the characteristics of the soldiers' heads, mandibles, or nasus.

Among the drywood termites, a soldier's globular ("phragmotic") head can be used to block their narrow tunnels. Termite soldiers are usually blind, but in some families, particularly among the dampwood termites, soldiers developing from the reproductive line may have at least partly functional eyes. The specialization of the soldier caste is principally a defence against predation by ants. The wide range of jaw types and phragmotic heads provides methods that effectively block narrow termite tunnels against ant entry. A tunnel-blocking soldier can rebuff attacks from many ants.

Usually more soldiers stand by behind the initial soldier so once the first one falls another soldier will take the place. In cases where the intrusion is coming from a breach that is larger than the soldier's head, defense requires special formations where soldiers form a phalanx-like formation around the breach and bite at intruders or exude toxins from the nasus or fontanelle. This formation involves self-sacrifice because once the workers have repaired the breach during fighting, no return is provided, thus leading to the death of all defenders.

Another form of self-sacrifice is performed by Southeast Asian tar-baby termites (*Globitermes sulphureus*). The soldiers of this species commit

suicide by autothysis—rupturing a large gland just beneath the surface of their cuticle. The thick yellow fluid in the gland becomes very sticky on contact with the air, entangling ants or other insects who are trying to invade the nest. [2][3] Termites undergo incomplete metamorphosis. Freshly hatched young appear as tiny termites that grow without significant morphological changes (other than wings and soldier specializations).

Some species of termite have dimorphic soldiers (up to three times the size of smaller soldiers). Though their value is unknown, speculation is that they may function as an elite class that defends only the inner tunnels of the mound. Evidence for this is that, even when provoked, these large soldiers do not defend themselves but retreat deeper into the mound. On the other hand, dimorphic soldiers are common in some Australian species of *Schedorhinotermes* that neither build mounds nor appear to maintain complex nest structures.

Some termite taxa are without soldiers; perhaps the best known of these are in the Apicotermitinae. [edit] Diet Termites are generally grouped according to their feeding behaviour. Thus, the commonly used general groupings are subterranean, soil-feeding, drywood, dampwood, and grass-eating. Of these, subterraneans and drywoods are primarily responsible for damage to human-made structures. All termites eat cellulose in its various forms as plant fibre. Cellulose is a rich energy source (as demonstrated by the amount of energy released when wood is burned), but remains difficult to digest.

Termites rely primarily upon symbiotic protozoa (metamonads) such as *Trichonympha*, and other microbes in their gut to digest the cellulose for

them and absorb the end products for their own use. Gut protozoa, such as *Trichonympha*, in turn rely on symbiotic bacteria embedded on their surfaces to produce some of the necessary digestive enzymes. This relationship is one of the finest examples of mutualism among animals. Most so-called higher termites, especially in the Family Termitidae, can produce their own cellulase enzymes. However, they still retain a rich gut fauna and primarily rely upon the bacteria.

Owing to closely related bacterial species, it is strongly presumed that the termites' gut flora are descended from the gut flora of the ancestral wood-eating cockroaches, like those of the genus *Cryptocercus*. Some species of termite practice fungiculture. They maintain a "garden" of specialized fungi of genus *Termitomyces*, which are nourished by the excrement of the insects. When the fungi are eaten, their spores pass undamaged through the intestines of the termites to complete the cycle by germinating in the fresh faecal pellets. 4][5] They are also well known for eating smaller insects in a last resort environment. [edit] Nests An arboreal termite nest in Mexico Termite workers build and maintain nests which house the colony. These are elaborate structures made using a combination of soil, mud, chewed wood/cellulose, saliva, and feces. A nest has many functions such as providing a protected living space and water conservation (through controlled condensation). There are nursery chambers deep within the nest where eggs and first instar larvae are tended. Some species maintain fungal gardens that are fed on collected plant matter, providing a nutritious mycelium on which the colony then feeds (see "Diet," above). Nests are punctuated by a maze of tunnel-like galleries that provide air conditioning



and control the CO<sub>2</sub>/O<sub>2</sub> balance, as well as allow the termites to move through the nest. Nests are commonly built underground, in large pieces of timber, inside fallen trees or atop living trees. Some species build nests aboveground, and they can develop into mounds. Homeowners need to be careful of tree stumps that have not been dug up.

These are prime candidates for termite nests and being close to homes, termites usually end up destroying the siding and sometimes even wooden beams. [edit] Mounds A termite mound (Macrotermitinae) in the Okavango Delta just outside of Maun, Botswana Wikimedia Commons has media related to: Termite mounds Mounds (also known as “ termitaria”[6]) occur when an aboveground nest grows beyond its initially concealing surface. They are commonly called “ ant hills” in Africa and Australia, despite the technical incorrectness of that name.

In tropical savannas the mounds may be very large, with an extreme of 9 metres (30 ft) high in the case of large conical mounds constructed by some *Macrotermes* species in well-wooded areas in Africa. [7] Two to three metres, however, would be typical for the largest mounds in most savannas. The shape ranges from somewhat amorphous domes or cones usually covered in grass and/or woody shrubs, to sculptured hard earth mounds, or a mixture of the two. Despite the irregular mound shapes, the different species in an area can usually be identified by simply looking at the mounds.

The sculptured mounds sometimes have elaborate and distinctive forms, such as those of the compass termite (*Amitermes meridionalis* & *A. laurensis*) which build tall wedge-shaped mounds with the long axis oriented

approximately north-south which gives them their alternative name of compass termites. This orientation has been experimentally shown to assist thermoregulation. The thin end of the nest faces towards the sun at its peak intensity hence taking up the least possible heat, this allows these termites to stay above ground where other species are forced to move into deeper below ground areas.

This allows the compass termites to live in poorly drained areas where other species would be caught between a choice of baking or drowning[8] The column of hot air rising in the aboveground mounds helps drive air circulation currents inside the subterranean network. The structure of these mounds can be quite complex. The temperature control is essential for those species that cultivate fungal gardens and even for those that don't, much effort and energy is spent maintaining the brood within a narrow temperature range, often only plus or minus 1 degree C over a day.

In some parts of the African savanna, a high density of aboveground mounds dominates the landscape. For instance, in some parts of the Busanga Plain area of Zambia, small mounds of about 1 m diameter with a density of about 100 per hectare can be seen on grassland between larger tree- and bush-covered mounds about 25 m in diameter with a density around 1 per hectare, and both show up well on high-resolution satellite images taken in the wet season. [9] Cathedral Mounds in the Northern Territory of Australia  
Magnetic Mounds (nearly North-South Axis)

Termite mound in Queensland / Australia Termites in a mound,  
Analamazoatra Reserve, Madagascar [edit] Shelter tubes Nasutiterminae

shelter tubes on a tree trunk provide cover for the trail from nest to forest floor. Termites are weak and relatively fragile insects that need to stay moist to survive. They can be overpowered by ants and other predators when exposed. They avoid these perils by covering their trails with tubing made of feces, plant matter, saliva and soil. Thus the termites can remain hidden and wall out unfavourable environmental conditions.

Sometimes these shelter tubes will extend for many metres, such as up the outside of a tree reaching from the soil to dead branches. To a subterranean termite any breach of their tunnels or nest is a cause for alarm. When the Formosan subterranean termite (*Coptotermes formosanus*) and the Eastern subterranean termite (*Reticulitermes flavipes*) detect a potential breach, the soldiers will usually bang their heads apparently to attract other soldiers for defence and recruit additional workers to repair any breach. This head-banging response to vibration is also useful when attempting to locate termites in house frames. edit] Human interaction[edit] Timber damage The result of an infestation is severe wood damage. Termite damage on external structure. Termite damage in wooden house stumps. Pacific Dampwood. Termite fecal pellets - distinctive hexagonal shape help identify this pest. Owing to their wood-eating habits, many termite species can do great damage to unprotected buildings and other wooden structures. Their habit of remaining concealed often results in their presence being undetected until the timbers are severely damaged and exhibit surface changes.

Once termites have entered a building, they do not limit themselves to wood; they also damage paper, cloth, carpets, and other cellulosic materials. Particles taken from soft plastics, plaster, rubber, and sealants such as

silicone rubber and acrylics are often employed in construction. Humans have moved many wood-eating species between continents, but have also caused drastic population decline in others through habitat loss and pesticide application. Termites are commonly viewed as pests in many countries, because of the damage they can cause to structures and similar nuisances.

In April 2011 wood-eating termites were blamed for reportedly consuming more than \$220, 000 worth of Indian rupee notes. [10] Precautions: Avoid contact of susceptible timber with ground by using termite-resistant concrete, steel, or masonry foundation with appropriate barriers. Even so, termites are able to bridge these with shelter tubes, and it has been known for termites to chew through piping made of soft plastics and even some metals, such as lead, to exploit moisture. In general, new buildings should be constructed with embedded physical termite barriers so that there are no easy means for termites to gain concealed entry.

While barriers of poisoned soil, so-called termite pre-treatment, have been in general use since the 1970s, it is preferable that these be used only for existing buildings without effective physical barriers. The intent of termite barriers (whether physical, poisoned soil, or some of the new poisoned plastics) is to prevent the termites from gaining unseen access to structures. In most instances, termites attempting to enter a barriered building will be forced into the less favourable approach of building shelter tubes up the outside walls; thus, they can be clearly visible both to the building occupants and a range of predators.

Timber treatment. Termite pre-treatment. Use of timber that is naturally resistant to termites such as *Syncarpia glomulifera* (Turpentine Tree), *Tectona grandis* (Teak), *Callitris glaucophylla* (White Cypress), or one of the sequoias. Note that there is no tree species whose every individual tree yields only timbers that are immune to termite damage, so that even with well-known termite-resistant timber types, there will occasionally be pieces that are attacked.

When termites have already penetrated a building, the first action is usually to destroy the colony with insecticides before removing the termites' means of access and fixing the problems that encouraged them in the first place. Baits (feeder stations) with small quantities of disruptive insect hormones or other very slow acting toxins have become the preferred least-toxic management tool in most western countries. This has replaced the dusting of toxins direct into termite tunnels that had been widely done since the early 1930s (originating in Australia).

The main dust toxicants have been the inorganic metallic poison arsenic trioxide, insect growth regulators (hormones) such as triflumuron and, more recently fipronil, a phenyl-pyrazole. Blowing dusts into termite workings is a highly skilled process. All these slow-acting poisons can be distributed by the workers for hours or weeks before any symptoms occur and are capable of destroying the entire colony. More modern variations include chlorfluazuron, diflubenzuron, hexaflumuron, and novaflumuron as bait toxicants and fipronil, imidacloprid and chlorantraniprole as soil poisons.

Soil poisons are the least-preferred method of control as this requires large doses of toxin and results in uncontrollable release to the environment. The termite's effects are damaging, costing the southwestern United States approximately \$1.5 billion each year in wood structure damage. In order to better control the population of termites, researchers at the Agricultural Research Service have found a way to track the movement of the destructive pests. In 1990, researchers found a way to safely and reliably track termites using immunoglobulin G (IgG) marker proteins from rabbits or chickens.

In field tests, termite bait was laced with the rabbit IgG and the termites were randomly exposed to feeding on this bait. Termites were later collected from the field and tested for the rabbit-IgG markers using a rabbit-IgG-specific assay. However, this method of testing for the tracking proteins is expensive. Recently, researchers have developed a new way of tracking the termites using egg white, cow milk, or soy milk proteins, which can be sprayed on the termites in the field. This new method is less expensive because the proteins can be traced using a protein-specific ELISA test.

The ELISA test is more affordable, because it is designed for mass production. Researchers hope to use this method of tracking termites to find a more cost-effective way to control the damaging pests. [3] Agricultural Research Service scientists have developed a more affordable method to track the movement of termites using traceable proteins. [2][edit] Termites in the human diet In many cultures, termites (particularly the winged ones known as alates) are used for food. The alates are nutritious, having a good store of fat and protein, and are palatable in most species with a nutty flavour when cooked.

They are easily gathered at the beginning of the rainy season in West, Central and Southern Africa when they swarm, as they are attracted to lights and can be gathered up when they land on nets put up around a lamp. The wings are shed and can be removed by a technique similar to winnowing. They are best gently roasted on a hot plate or lightly fried until slightly crisp; oil is not usually needed since their bodies are naturally high in oil. Traditionally they make a welcome treat at the beginning of the rainy season when livestock is lean, new crops have not yet produced food, and stored produce from the previous