

# Termites

## ***1. Features of Termites:***

1. Termites are pale-coloured and usually blind except macropterous forms.
2. Termites possess comparatively large head, chewing and biting mouth parts.
3. Well-developed eyes in reproductive castes.
4. Ocelli are either touching or away from the eyes.
5. Soft-bodied females have much enlarged abdomen.
6. Winged (alate) and wingless (apterous) forms are composing the colony.
7. In winged forms, the fore-wings and hind-wings are same sizes.
8. The colonies contain many castes, such as queen, workers, soldiers, etc.

## ***2. Distribution of Termites:***

The termites are broadly divided into two categories—lower termites and higher termites.

### **The lower termites include the following families:**

#### **1. Mastotermitidae:**

It includes the most primitive living termite, *Mastotermes darviniensis*. It is found in Northern Australia and Papua, New Guinea. No primary queen has ever been recorded in the field and numerous substitute queens are usually found in the nests.

#### **2. Kalotermitidae:**

They are known as dry wood termites because they live in dry wood although some dry wood termites have subterranean habits. There are 400 species and are distributed throughout the world.

#### **Examples:**

*Kalotermes*, *Glyptotermes*.

#### **3. Termopsidae:**

They are known as damp wood termites because they live in wet and rotting wood. There are about 20 species and are distributed in the forests of America, Eurasia, Africa and Australia.

#### **4. Hodotermitidae:**

They are known as grass harvesting termites because they have adapted in grass land where the trees are scanty. They are found in India and Africa.

#### **Examples:**

Hodotermes, Anacanthotermes.

#### **5. Rhinotermitidae:**

Known as subterranean termites except Coptotermes, Reticulitermes. Some mound-builders and aerial nesters are found in this family. About 300 species have been recorded and are distributed in most of the continents.

The higher termites include a single family, Termitidae with several subfamilies.

#### **6. Termitidae:**

They build generally clay nests of great height above ground (also called termitaria) that occur in tropics including Asia, Africa, Australia and South America. About 1800 species have been recorded. Examples are Amitermes, Microcerotermes, Termes, Cubitermes, Capritermes, Nasutitermes, Macrotermes, Microtermes, Odontotermes.

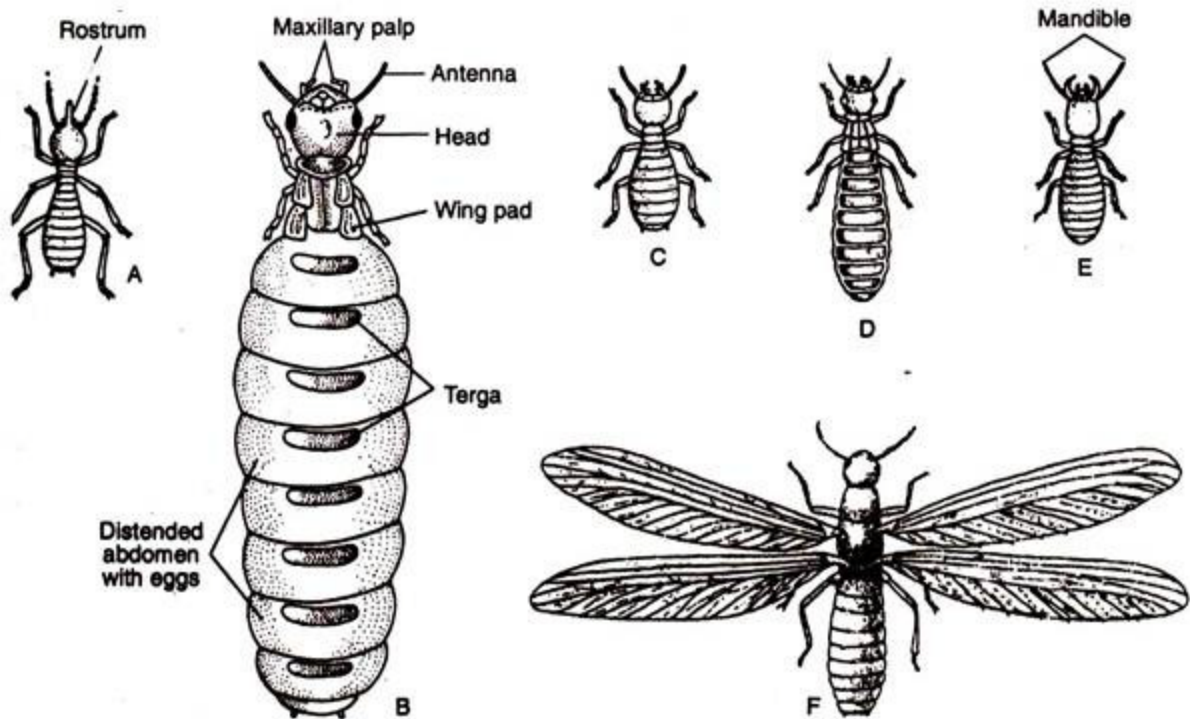
The lower groups of termites contain symbiotic intestinal protozoa and bacteria, and higher termites contain intestinal bacteria only.

#### **3. Social Organization of Termites:**

**“Social organisation is a process in which single or both parents live under a shelter and perform the activities in an organised and co-operative manner for the maintenance of the community”.**

The detailed account of termites was published first in the Royal Society of London in 1781 by Henry Smeathman. The account was based on African termites.

A typical colony possesses nymphs (semi-matured young's), workers, soldiers and reproductive individuals of both sexes (Fig. 18.91A, B, C, D, E, and F); sometimes also several egg laying queens are included. The different types of insects, each having a particular function live in a colony, called castes.



**Fig. 18.91:** Different forms in a termite colony. A. Nasute, B. Queen or female, C. Worker, D. Male, E. Soldier, F. Winged male.

#### 4. Caste System of Termites:

A termite colony includes two major castes—sterile castes and reproductive castes. The caste system and the size of the colony are controlled by a pheromone, called social hormone, which is secreted by the members of reproductive castes (e.g., king and queen).

##### A. Sterile castes:

They are incapable of reproduction and include usually workers and soldiers (Fig. 18.91).

##### (i) Workers:

They are sterile of both sexes and developed from the fertilized eggs. They constitute major numbers in a colony and occupy 80%-90% of the total number. They are small-sized individuals measuring about 6 to 8 mm in length which bear chewing mandibles and usually lack of eyes.

But workers of some harvesting species bear well developed compound eyes. They have no wings (apterous). They feed upon the wood or fungus products. Advanced termites produce true workers but in primitive families (e.g., Mastotermitidae, Kalotermitidae, Termopsidae, Rhinotermitidae) the true workers are not found.

Instead, nymphs (an insect larva hemimetabolous insects, resembling the adult except they have no wings and reproductive organs) of various stages which are arrested in their development act all the domestic duties of the nest like the workers, called Pseudergater or false worker, found in the colonies of Kalotermitidae.

They persist as worker throughout life or can metamorphose into winged reproductive castes and also act as potential supplementary reproductive castes.

### **Division of labour:**

Workers perform all the duties for the colony except reproduction. They take care of the eggs and young, undertake the labours of food gathering, food storage and feed the nymphs, king and queens.

They take part in the building of nests and in the cultivation of fungus-garden in special chambers in the subterranean channels. They also maintain the moisture in the interior of a nest of a colony. They perform defense duties in some species and also clean the other castes.

### **(ii) Soldiers:**

The soldiers of some species of different genera show great diversity in characters. They are developed from the unfertilized eggs. They are wingless and larger than the workers. Soldiers are more or less pigmented and possess large head and stout, powerful mandibles.

They are mostly devoid of eyes but occasionally appear in some species (e.g., Mastotermes, Hodotermes, etc.). They constitute 5-8% in number in a colony. Soldiers for food rely on workers. They maintain the defense of the colony.

The specialized forms of soldier termites within many species of the family Termitidae, called nasutes. They are characterized by the reduced mandibles and head which is continued as a rostrum, at the tip of which opens a frontal gland.

The secretion of this gland is acrid which helps to prevent enemies and at the same time it dissolves hard substances including concrete structures. In some Rhinotermitidae, the soldiers are specialized with a pair of large strong mandibles and highly elongated grooved labrum that contains defensive secretions, called nasutoid soldier (e.g., Nasutitermes).

### **B. Reproductive castes:**

These are fertile and are characterised by the presence of the eyes.

**From the functional point of view, the reproductive castes are of three types:**

**1. Macropterous or large winged or primary reproductive forms (Fig. 18.91):**

These sexually matured males and females have two pairs of wings longer than the body and convert kings and queens. The body is usually pigmented and may be yellow, brown or black. The widely separated large compound eyes and paired ocelli are usually present. The royal pair or the sexually active males and females of social insects are the original founders of the colony.

**King:**

Usually there is a single king in a colony. It is smaller than the queen. Its function is to mate intermittently and provide sperm to the queen.

**Queen:**

The queen is also a single in a colony which is largest in size measuring 60- 80 mm in length. It lays eggs after mating and can lay more than 1000 eggs per day. Both king and queen live in a special chamber, called nuptial chamber.

It is widely believed that the queen or king is the primary source of a pheromone (also called social pheromone) that maintain the colony integration and the size of the colony. The colony integration is also maintained by the exchange of food, saliva or some secretions among colony members. This process is called trophallaxis.

**2. Brachypterous neotenic or short winged or substitute reproductive forms:**

When the primary or original king or queen dies or gets old, its place is taken by the sexually mature male or female but in nymph form. To replace them, the nymphs of the suitable sex (male or female) attain maturity by special feeding without further moulting and become the substitute queen.

The substitute reproductives are characterized by the presence of short pad-like wings, ocelli and rudimentary compound eyes and small reproductive organs. The substitute reproductives vary in number in different species within colony. It is recorded fifty functional substitute queens in a colony of *Hodotermes*.

Grassi and Sandias reported the condition of castes in the nests after examination of thousand colonies in Italy where they found none of the primary reproductives in a single colony and only substitute reproductives numbering 10-200 per nest.

**3. Apterous neotenic reproductives or wingless forms or replacement reproductives:**

If queen dies in some adverse conditions or gets old, the apterous neotenic reproductives are produced. In some primitive subterranean species, like *Reticulitermes flavipes*, *Reticulitermes mallei*, the nymphs or ergates (workers) are without wings and possess less developed eyes, and reproductive organs become a functional reproductive in the colony with one or two moults.

The workers and soldiers are usually blind and live deep in the soil of the mound, so they do not require vision and always remain in close contact of food source. The reproductive adults have well developed eyes because the vision is required for flight and in search of nest sites.

### ***5. Food and Feeding of Termites:***

The eusociality of termites largely depends on food and feeding. After the production of workers and nymphs, the king and queen are fed by the workers. The mutual exchange of food, salivary secretion and other secretions among the members of termites are called trophallaxis.

#### **The social insects exchange food in two ways:**

(i) Stomodaeal trophallaxis and

(ii) Proctodaeal trophallaxis.

Stomodaeal trophallaxis is related to the exchange of food among the members through mouth to mouth but in proctodaeal trophallaxis, the exchange of food and symbiont through anus to mouth. In termites and cockroaches, the proctodaeal trophallaxis is crucial for the replacement of endosymbionts that are lost after every moult and this behaviour is used to the origin of sociality in insects.

On the basis of feeding, termites can be divided into wood (cellulose) eating and, or litter feeding, fungus-growing and soil-feeding types.

#### **(i) Wood (cellulose) eating termites:**

The wood (cellulose) eating termites (e.g., *Archotermopsis*, *Zootermopsis*) feed on cellulose of the wood, collect either from living or dead plants. The cellulose is a polysaccharide, each containing three thousand sugar units and important structural component of the cell wall of plants.

The termites possess intestinal fauna of symbiotic protozoa (e.g., *Trichonympha*) which help to digest the cellulose, secreting cellulase enzyme. These protozoans enter the nymphs which consume the excrement of the adult. The recent molecular evidence indicates that termites also use own enzymes for cellulose digestion.

**(ii) Soil-feeding Termites:**

The soil-feeding termites are *Cubitermes*, *Termes*, *Capritermes* (Subfamily Termitinae, Family Termitidae) which consume large quantity of soil as a food.

In these higher termites they have lost the symbiotic intestinal protozoa, and only gut bacteria is found which can degrade soil organic matter that provides the termite host with nutrition. The excreta contain a mixture of clay and broken down vegetable debris, used for the construction of mounds and galleries.

**(iii) Fungus-growing termites:**

Fungus-growing termites are small insects, ranging 4 to 15 mm long and belong to the subfamily Macrotermitinae, feeding on wood and plant fibres using detritus. These termites could not digest cellulose and need help digestive capabilities of fungi *Termitomyces* (Basidiomycetes). Macrotermitinae cultivates a fungus-garden around the colony and creates some ventilated structures inside the nest in the form of fungi combs.

The termites consume cellulose-based materials like woods and vegetable debris; they also eat a certain amount of fungi. These fungi help the digestion of food inside the bodies of termites that help in the breaking down of ligneous and cellulose based substances.

***6. Swarming and Formation of a New Colony by Termites:***

Swarming is the concerted departure of the winged termites from the main colony to start new colonies, accompanying by a queen or males or females together, generally occurring during rainy season. Before mating, the new kings and queens leave the colony and fly for a while.

The kings and queens that take part in the swarming, called alates or swarmer's. The mating flight of the royal pair is known as nuptial flight. But it is not a true nuptial flight in termites because the copulation does not take place during flight. Generally after flight the males and females fall on ground, discard their wings, choose their mates, and find a suitable place nearby for nesting.

Swarming behaviour of the opposite sexes is different in different families and genus. The behaviour pattern in primitive families like *Kalotermitidae* is most simple. They are crepuscular flier. Male and females fall on the ground after flight and wait for the opposite sex.

Before mating, the wings are shed and after pairing they excavate a chamber in a suitable place. In higher termite species the female usually alights first on the ground after flight and shows an attractive altitude elevating its abdomen.

The female releases a pheromone, a social hormone that attracts the males. Before mating, they shed their wings and dig a chamber nearby in which they take shelter and where copulation takes place.

### **Termitarium:**

Generally termites construct colony by digging tunnels underground (e.g., *Odontotermes assumthi*, *Microtermes obesi*, etc.) or make a large mound above ground or nests are inside wood of trees or buildings. The common termites which build clay nests of great height [Fig. 18.92(i)] above ground are *Odontotermes redemani*, *O. obesus*, etc.

A termite nest (termitarium) presents highest form of architecture and within the nest there is a special chamber where the queen and a few males are confined.

The special chamber is called nuptial chamber. A colony [Fig. 18.92(ii)] includes nurseries, chambers, royal chambers, special chambers for cultivating fungus-gardens or storing food, guard rooms, bridges, corridors and subterranean streets and canals [Fig. 18.92(ii)].

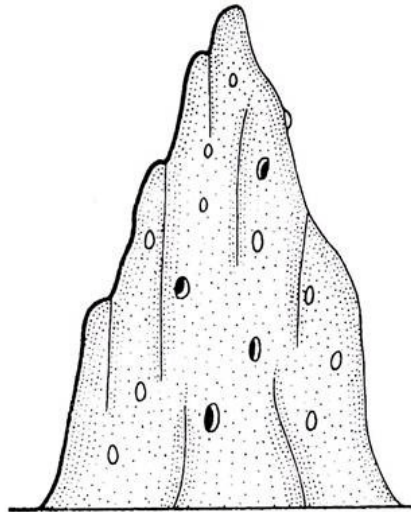


Fig. 18.92(i): A clay nest (termitarium) of a termite colony (from other source).

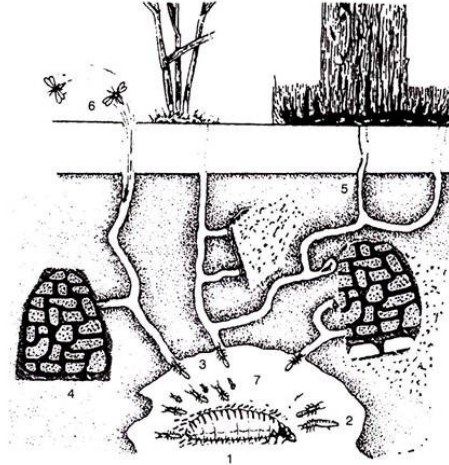


Fig. 18.92(ii): Organization of a colony of termites. 1. Queen, 2. King, 3. Soldier, 4. Sectional view of a fungus garden, 5. Tunnels towards wood for attack, 6. Adults coming out for the construction of a new colony, 7. Nuptial chamber (from different sources).

The period of swarming occurs at different times of the year. The swarming period of *Odontotermes* usually occurs during rainy season one hour after and of course half an hour after rainfall. In dry-wood termites the swarming occurs in hot days during summer season. During flight most of the termites are eaten by birds, small mammals or destroyed.

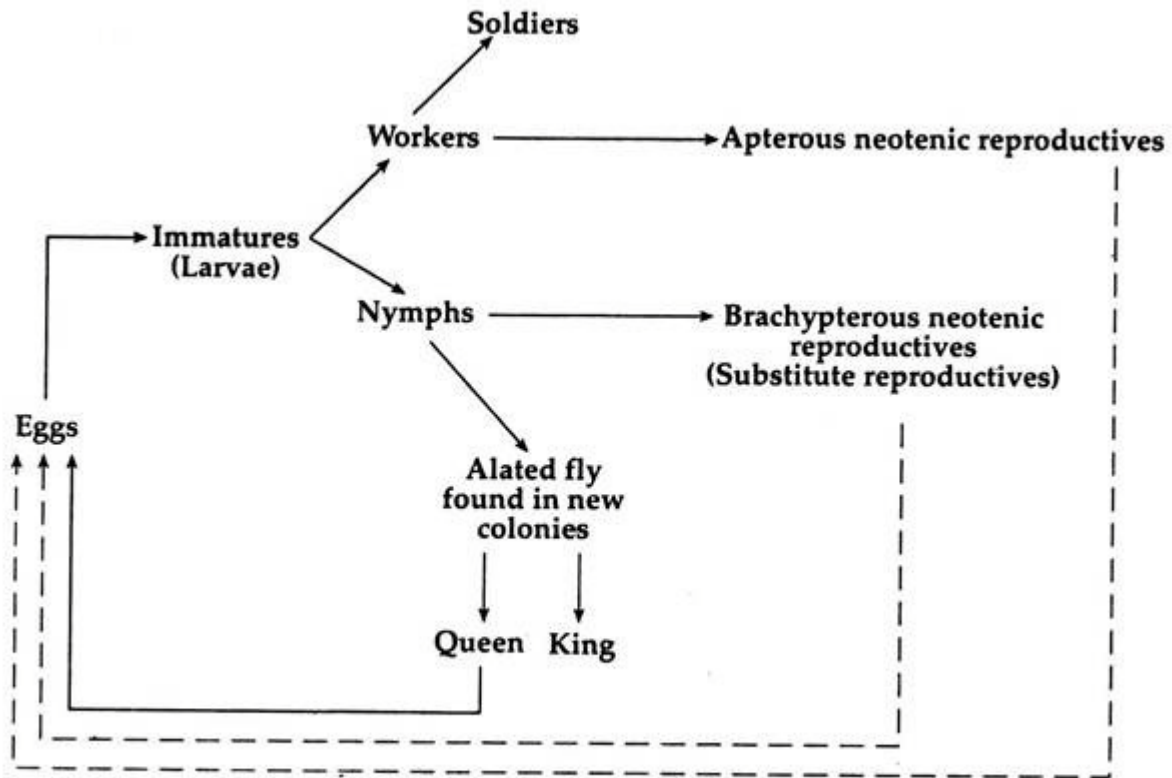
### **7. Development of Termites:**

After copulation, the queen produces a large number of eggs, most of which develop into nymphs. These nymphs develop into sexless workers, soldiers and substitute reproductive forms and may become sexual forms, if necessary. The queen at that time is specially fed and it grows to a large size.

The large size is due to enormous growth of abdomen in which huge quantities of eggs are deposited. This abnormal-sized abdomen is known as physogastrous and the termite queen containing such distended abdomen, called physogastrous female. After copulation the queen starts laying eggs in a chamber, called royal chamber, but the egg-laying capacity is not equal in all families or species.

In primitive termites the egg-laying is intermittent and the population is small. In *Coptotermes* the queen lays 100 eggs per day, but in advanced termites the queen can produce 30,000-40,000 eggs per day and 10 million a year.

In the primary stages of the colony the nymphs hatch from the eggs within few days and moult at least three times to become functional workers, and into soldiers after fourth moults, and also substitute reproductives develop from nymphs (Fig. 18.93).



**Fig. 18.93:** Life cycle of the termite.

But at the end of winter several sexual forms appear. When matured, these winged forms take colonising flight, which occur during rainy season.

The wings in them extend beyond abdomen and are membranous. After becoming functional workers and soldiers, they take charge of the nest and take proper care of their parents. They expand the nest and make adequate arrangements to accommodate the growing population.

### **Longevity:**

Primary queens can survive for 15-20 years and some may live for 50 years. Aborigines in Australia have reported that the termite queens of mounds can survive up to 70 years. Workers may only live for a few months. Mastotermes kings have been recorded about 16 years.

The longevity of the individuals of the different castes in the colony is an important factor in establishing the close relationship between successive generations which form the basis of social organization or eusociality of termites.

### **Communication:**

Termites communicate each other in a colony through chemical, acoustical and tactical signals. The sexual communication and trail following of the termites are connected each other by pheromones. There are two pheromones in termites, such as (ZZE)-(3, 6, 8)-dodecatrienol and (E)-6-cembrene, have been recognised as trail pheromones.

**8. Economic Importance of Termites:**

1. The workers and soldiers leave their nest at night to attack furniture, woods and books.
2. Thus they damage human properties in several ways.
3. The only way to get rid of termite menace is to destroy the queen.
4. In spite of its destructive role, the termites are considered important from the point of view of agriculture.
5. Like earthworm, the termites also pulverise the soil and make it fertile.
6. Swarming termites are taken as food by birds and other animals.