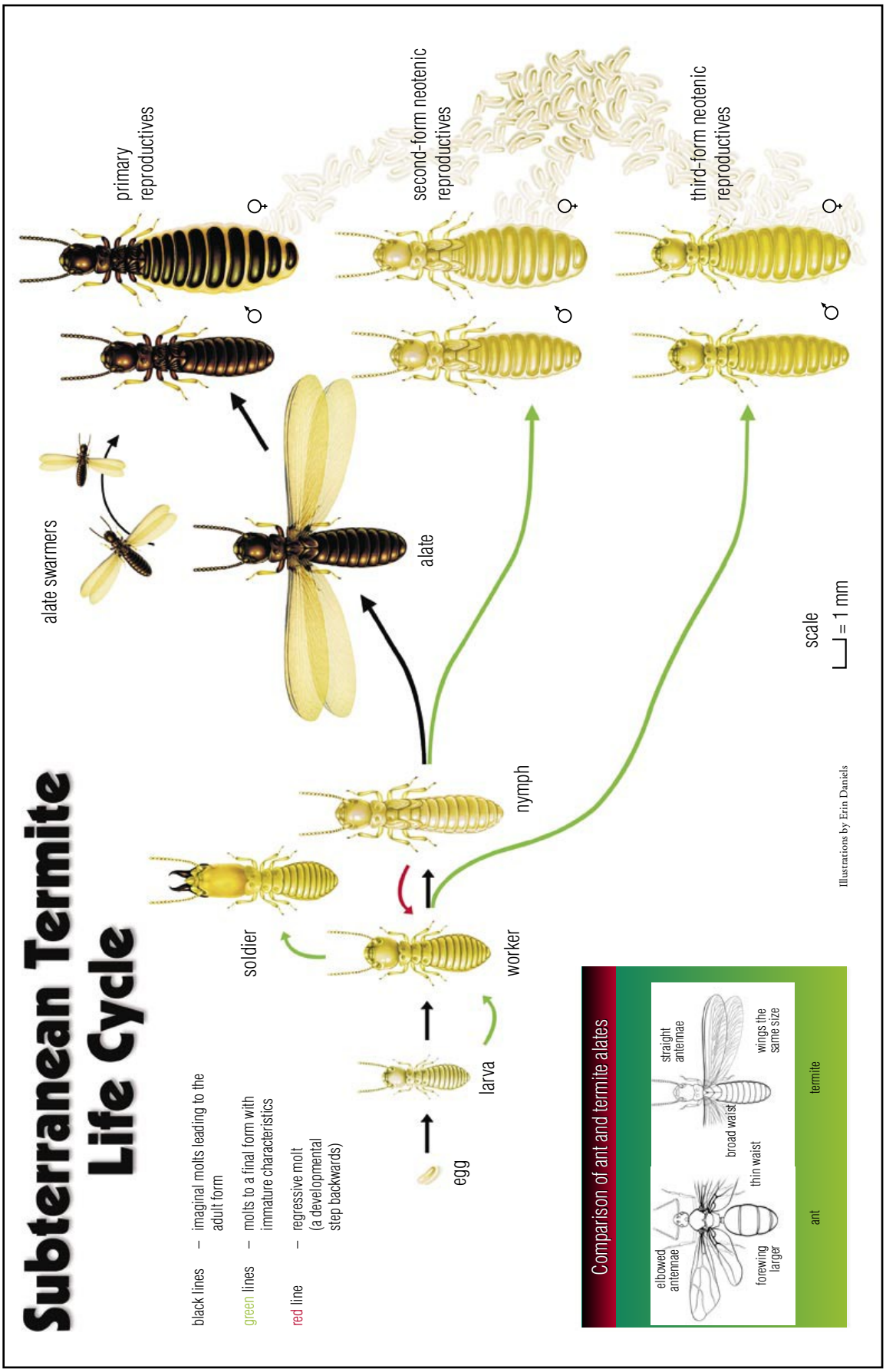

Figure 2-1. This diagram shows each newly hatched termite can develop into any one of a number different castes depending on the changing needs of the colony.

Chapter 2

Termite Identification and Biology

There are over 45 different species of termites found in the United States. Only two species, the eastern subterranean termite *(Reticulitermes flavipes)*, and the arid land subterranean termite *(R. tibialis)*, are native to Nebraska. This chapter will concentrate on subterranean termite identification, biology and behavior, factors critical to making appropriate decisions about termites and termite control.

Identification

Termites are insects. They have three main body parts: head, thorax and abdomen. On their head, termites have a distinctive pair of straight antennae that look like small beads connected together. Since insects don't have a nose to "smell" their environment, antennae are used as scent organs, along with other sensory organs on various parts of their body.

The thorax is subdivided into three segments and is the part of the body where movement is based. As other insects do, termites have three pairs of legs—one attached to each segment on the thorax. The winged reproductives (swarmers) have a pair of nearly identical wings attached to the last two thoracic segments (see figure 2-1). These nearly identical pairs of wings give termites their scientific name; the termite order Isoptera, comes from *iso* meaning equal and *ptera* meaning wings. The termite workers and soldiers do not have wings.

The abdomen is where the digestive, respiratory, circulatory and reproductive systems are located. The termite digestive system is interesting, because termites require gut symbionts, bacteria and protozoans that have the ability to break down cellulose into simpler components the termites can digest. Without these microorganisms in the gut, termites would not be able to feed on wood. These microorganisms are passed to the larval termites through the process of trophallaxis, the exchanging of body fluids. The importance of trophallaxis will be discussed later.

The reproductive system of the queen is also remarkable. After mating, the abdomen of a queen enlarges, and she becomes an egg factory. A mature queen of some species is capable of producing up to 10,000 eggs per week; that's over three million eggs in a year! Since she can live for a decade or longer, she can produce an amazing 30–60 million eggs in her lifetime. Neither workers nor soldiers have the capability to lay eggs and are sterile.

Ants versus Termites. People sometimes confuse ants with termites because both live in the soil and their winged forms are similar in appearance. Termites and ants

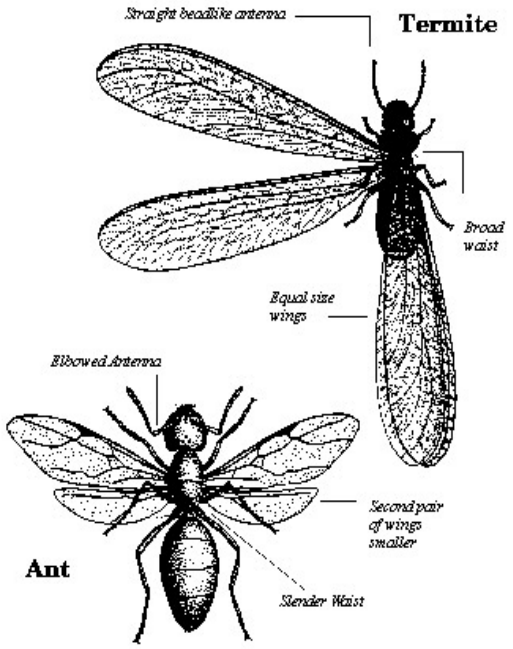

Figure 2-2. Winged ant and termite swarmer.

can also swarm at the same time of year, which adds to the confusion. Upon closer examination, there are several key differences in the appearance of these two distinctly different types of insects.

1. Termite workers are white to greyish, whereas ants are darker in color. Swarming termites are dark, often black in color. These are the termites often confused with ants.
2. Termites have straight bead-like antenna; ants have "elbowed" antennae.
3. Ants have a constricted "waist" where the thorax and the abdomen are connected; termites have an abdomen that is broadly joined at the thorax.
4. Finally, winged ants have forewings (the first pair) larger than the hindwings. Winged termites have two pairs of wings equal in size and appearance.

Even though they are similar in appearance and live in the soil, ants and termites are enemies because many ant species are predators of termites.

Social Behavior. Another way termites are similar to ants is both are truly social insects. True sociality in insects is found only in the Hymenoptera (ants, bees, some wasps) and Isoptera (termites). These social insects are among the most successful insects in terms of being able to exploit their environment.

Grooming Habits. Communication between termite colony members is essential for a colony to function properly. The queen produces chemical messages that are transferred to all members of the colony. The spreading of chemical messages is done through a frequent activity called anal trophallaxis, the exchange of fluids from the anus to the mouth. Workers lick and groom the queen and then feed and groom other colony members. This is a less than appealing behavior, but it is a very efficient way of transferring chemical messages throughout the colony.

Trophallaxis also serves to transfer microorganisms that live in the gut to all members of the colony. The baiting systems rely on trophallaxis to distribute bait throughout the colony.

Caste System. A termite colony is highly structured and has castes that perform distinctly different duties. There are three castes that vary in form and function. Recent studies indicate the caste system in termite colonies is very dynamic.

Reproductive Castes. The reproductives produce all other members of the colony and play an important part in dispersal and formation of new colonies. There are three types of reproductives in a termite colony: the primary, secondary and tertiary reproductives.

Primary Reproductives. When a colony is very successful, some nymphs (indicated as "larvae" in figure 2-1) will develop wing pads, and at the final molt, turn dark and emerge as fully-winged adults — the future "swarmers". When environmental conditions are right, often after a period of rainy weather, winged swarmers will travel through the mud tubes wingless workers have built. Instead of shunning the light like worker termites do, they break through the tubes, pour out of the soil, and fly off to start a new colony. In Nebraska, eastern subterranean termites usually swarm in April or May, often occurring after a rainy period when the ground is soft.

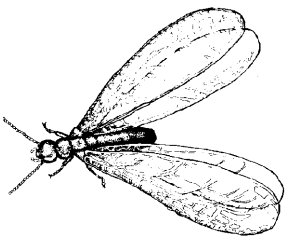

Figure 2-3. Termite "swarmer" reproductive.

After the "nuptial flight," the males and females pair on the ground, and their wings break off at a line of weakness near their base. Courtship involves tandem running, where termite pairs run on the ground with the male closely following the female. When the queen finds a suitable nesting location, they stop and excavate a small chamber in the soil and mate.

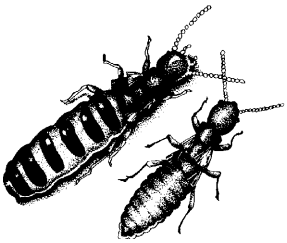

Figure 2-4. Queen termite (left) and king termite.

During the first few years, a termite colony grows slowly. Studies have shown that after two years, there may be only a few hundred colony members.

It typically takes four to ten years for a new subterranean termite colony to produce swarmers, longer if conditions are unfavorable.

When termites swarm inside a home, it often means the worker termites have found a way inside and there are mud tubes connecting the colony with the structure. It can indicate a serious termite problem.

Secondary Reproductives. When a colony gets very large, the queen cannot lay enough eggs to keep up with the colony's demand, so sexually competent females and males are produced called secondary reproductives. The female secondary reproductives lay fewer eggs than the queen, but there can be hundreds of secondary reproductives in an established colony. Because of their numbers, they are the most important source of new eggs and allow the termite colony to increase rapidly in size. They are also important because the reproductive needs of the colony can be entirely taken over by these secondary reproductives if the queen dies.

The secondary reproductives are smaller than the queen, but larger than the workers. Both males and females lack membranous wings, but some have tiny wing buds.

The colony consists of a main colony, where the primary queen lives, and satellite units, where the secondary reproductives are laying eggs. These are linked together by a network of underground tunnels. Over time, these units may become isolated from one another to the point where the termites no longer interact. This type of colony expansion is called "budding", where a number of workers or secondary reproductives can be cut-off from the main colony and form a new, self-sufficient colony.

Tertiary Reproductives. When part of the colony is "cut off" from the queen, fully developed workers can become reproductives. This process occurs "on-the-spot" requiring no interaction with the queen or the original colony. The resulting ergatoid (tertiary) reproductives are wingless and look like big workers. They can produce two to three times more eggs than primary queens, however, this accelerated reproductive rate may be short-lived. Research is on-going to learn more about this process.

Worker Caste. Workers are the most numerous caste in a termite colony and are white or cream-colored, soft-bodied and prone to desiccation (dehydration). They are also blind and wingless. To prevent desiccation, they live underground, inside wood or inside the mud tubes that they construct. They are rarely seen unless infested wood is examined or mud tubes are broken open.

Most termite workers spend their entire lives feeding and maintaining the colony. Workers forage for all the food that feeds the entire colony. They also construct mud tubes, excavate chambers and repair the nest when damaged. They feed all the colony members and groom and take care of the young nestmates. The young workers

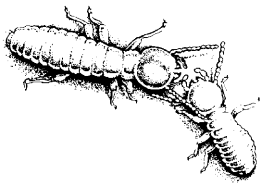

Figure 2-5. Worker termite (left) and immature termite.

Figure 2-6. Soldier termite.

stay in the colony, caring for the eggs and nymphs while grooming and feeding others. The older, stronger and larger workers construct the nest and forage for food. Termite workers reach maturity within a year and can live about two years.

Soldier Caste. In strong colonies, some nymphs will develop into wingless, light-colored termites with large heads and brown, well-developed jaws. They are larger than workers. These soldier termites defend the colony from attack by ants or other termites. The soldiers are much less numerous than the workers. They hide within the mud tubes and in the nest and will not be seen unless the wood or mud tubes are disturbed.

Biology

Temperature. Like other insects, termites are "cold-blooded," meaning termites live and forage in the soil at a temperature comfortable for them and will not be found where the temperatures are too cold or too hot. During the winter, in northern areas of the U.S., termites cannot cross a frost barrier to forage at the soil surface but may be active deeper in the soil. When temperatures warm in the spring and summer, termites will be found near the soil surface.

This temperature effect means firewood stacked outdoors cannot have active termites in it in the middle of the winter when temperatures are below freezing. It also means many termite infestations in Nebraska are seasonal and are active only between March/April through October/November. Another fact is termites are not likely to find bait stations placed at the soil surface during colder months of the year, although the termites may be active at deeper soil levels.

Heated basements can create an environment where termites, having entered the basement through cracks in the foundation below the frost line, can feed year round undetected and uninterrupted by cold winter conditions. This, coupled with our inclination to finish our basements by covering walls and ceilings, creates optimal conditions for termites to do serious damage and remain active throughout the year.

Moisture. To maintain a moist environment above the ground, workers continually carry moist soil above ground for use in constructing mud tubes. This termite "mud" is tiny particles of soil, wood or debris cemented together with saliva and fecal matter. In addition to building tubes, termites leave mud in wood they have excavated. This mud is so characteristic that termite-damaged wood can be readily identified even if no termites are found with it. Active termite tubes are kept moist to maintain a high humidity in the gallery system.

If the wood above the ground is moist enough, subterranean termites can survive and multiply indefinitely with no direct-ground contact. These above-ground colonies are called "satellite colonies." Since they require a regular moisture source, these above-ground colonies are quite uncommon. The presence of secondary queens or tertiary reproductives can be a sign of a satellite colony. Treating an above-ground satellite colony is difficult because barrier treatments nor baits placed in the soil, will eliminate their feeding. To eliminate a satellite colony requires you first solve the water problem allowing the colony to live above the ground.

Because of moisture needed by termites, houses with water problems near the foundation and overgrown vegetation too close to the house, may be more at risk. More information can be found in Chapter 4, Preventing Termite Damage.

Searching for Food. Researchers have traditionally thought termites move "randomly" in the soil. This was because it is virtually impossible to see how these soil-dwelling insects actually travel in the soil. But recently, studies have shown termites actually move in very predictable ways. Scientists have discovered their movement is much more efficient than if it was merely random. As they travel away from the colony, termites construct branching tunnels in a radial pattern similar to the spokes in a wheel. This pattern evenly divides and sub-divides the search area so the termites cover it as completely as possible.

Termites probably don't detect wood from appreciable distances because the soil environment doesn't allow chemical cues to travel very far. They certainly can't "tell" where your house is. We think termites find food by almost "bumping" into it during their foraging activities. Termites also tend to travel along below-ground objects, like roots, stones, basement foundations, pipes and other objects because it is easier to follow these objects than to tunnel through soil. They may avoid areas that are extremely compacted.

Termites respond to environmental cues, like temperature and moisture gradients. During Nebraska's winters, they move down into the soil because they cannot cross the frost barrier. During dry periods, termites move deeper into the soil or seek artificially moist areas—for example, in well-watered gardens. During the summer in Nebraska, termites will be found in the upper soil levels where most roots are found.

Once termites find food, they will stop and feed. More termites will be sent to the food-rich area. Marginal food resources may be abandoned, although, once they have a connection with a food source, they will be able to find the food again if needed. During the winter, some food

resources will be abandoned because of cold conditions, but feeding may resume the following spring or summer. Seasonal feeding is why inspections during the winter are not as likely to find live termites as in the late spring or summer.

If termites come across a physical barrier in the soil, like a basement foundation, they may either move horizontally along it, or they may move vertically up the foundation. If they find a crack in the foundation greater than 1/64-inch, they may explore it. If their mud tube becomes exposed to dry air, they may stop and change direction to avoid desiccation.

Food Preferences. The main nutritional ingredient in the food termites eat is cellulose, the hard structural component of wood and other plant tissues. Termites will feed on nearly any source of cellulose, including wood, roots, twigs, mulch, paper, cardboard and fabrics made of cotton and other plant-based materials. Subterranean termites have been found infesting living trees, but it is unclear whether they destroy living tissues or are feeding only on dead areas.

Subterranean termites tend to prefer softer woods over hard wood, but no untreated wood is completely resistant to termite attack. They typically eat the softer spring wood and leave the harder summer wood which results in the wood being hollowed out between the growth rings. Termites are most attracted to wood partially decomposed and attacked by fungi; studies have shown they thrive on decaying wood. Wood that is on or in the soil or has been saturated with water is much more suitable for termites than dry, structural wood. Some types of wood (redwood, cypress, junipers) are more resistant to termites because of naturally occurring substances in them. However, during the weathering process, the repellent substances (oils and resins) leach, and the wood loses its resistant quality.

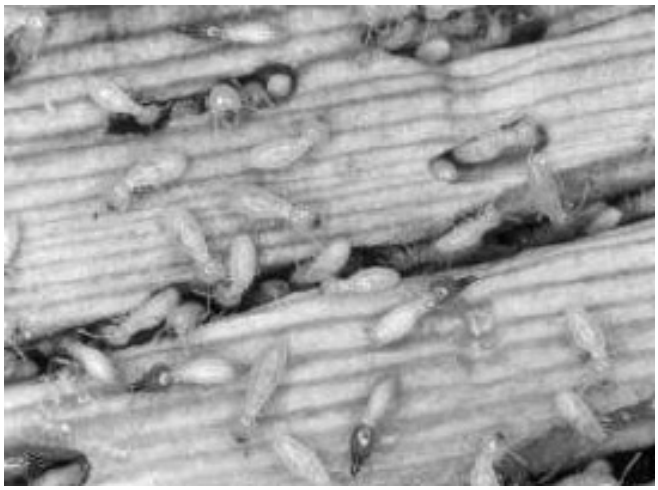

Figure 2-7. Termites feeding on wood.

Even though termites feed on cellulose, they can penetrate and damage non-cellulose materials, including plaster and drywall, stucco, plastics, neoprene and rubber. Termites will damage vinyl swimming pool liners, pool filters and heater lines. Softer metals, such as lead, copper and aluminum, have been damaged as well as linoleum, asphalt, PVC pipes and rigid board insulation constructed of polystyrene (Styrofoam®).

Damage. The amount of damage termites can do to a structure depends on a number of factors.

1. Colony size. It should be obvious the more termites that feed on the structure, the more damage that is done. Within a colony, it is not likely all the termites are feeding on only one source of wood. Alternative food sources in the area, like dead tree stumps and roots, mulch and woodpiles, increases the number of food sources for termites.

What is the size of a termite colony? A lot of researchers have attempted to calculate how large termite colonies are. This is no small task, because of the underground nature of termites. One expert—Michael Potter, University of Kentucky—has concluded the sizes and foraging ranges of termite colonies are highly variable. Some colonies have been estimated to have hundreds of thousands to millions of individuals with a foraging range of up to half an acre in size. Other termite colonies are smaller and may have only 10,000 individuals that may travel less than 20 feet. Because they are highly variable, it is difficult to generalize about the size of an "average" termite colony.

2. Duration of feeding. In northern climates, like Nebraska, many termite infestations may be seasonal, unless of course, termites have entered the structure below the frost line.

3. Type of termite. Some termites have greater appetites than others. For example, the Formosan termite found in the southern U.S. is much more aggressive and eats more than the subterranean termites found in Nebraska.

There are few studies that have documented the damage from subterranean termites in the Midwest. Most of this kind of research comes from southern states. A 1996 research study in Georgia monitored wood consumption by subterranean termite colonies by putting pieces of wood below the ground. This study examined 60 termite colonies over a three-year period. The researchers found the average amount consumed per colony was equivalent to one five-inch section of pine 2x4 each year. If this study were done in Nebraska, we would expect this amount to be less, because of the climate differences already discussed. In addition, subterranean colonies in Nebraska may be larger or smaller than the ones (average less than 100,000 termites) that were looked at in Georgia.