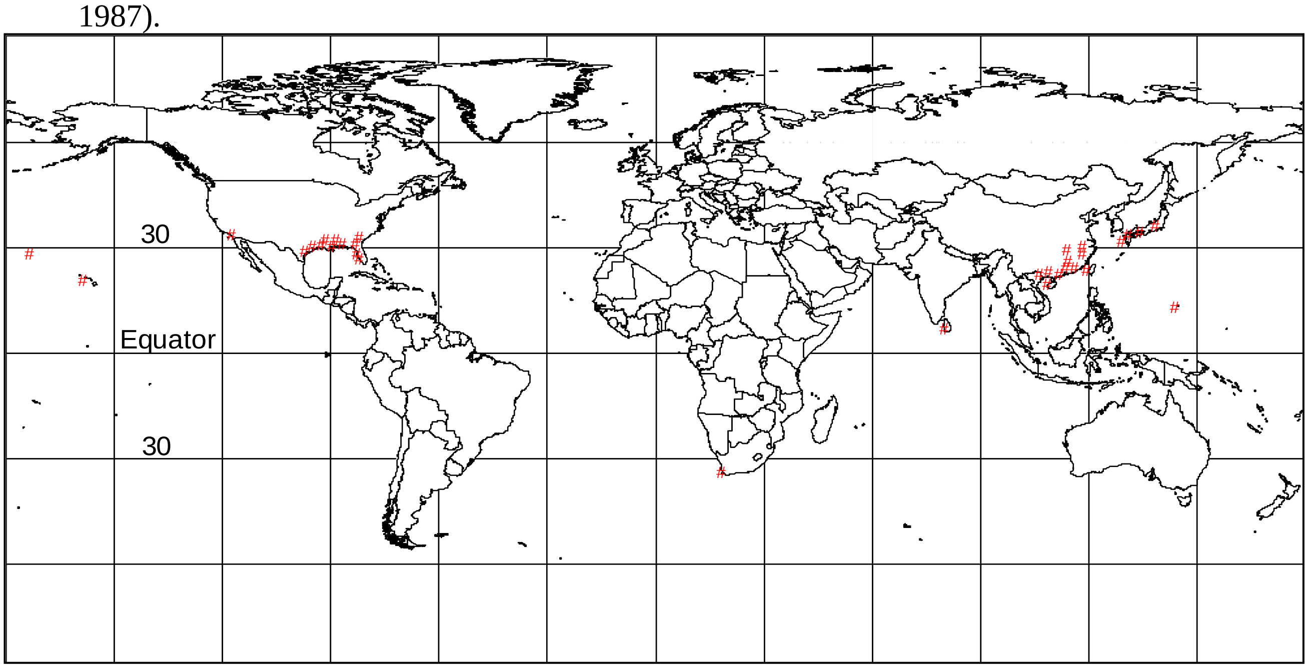
The Formosan Subterranean Termite

The Formosan subterranean termite, *Coptotermes formosanus*, is a pest of major economic importance in New Orleans, Louisiana and other areas of the southeastern United States. This exotic pest was introduced into United States port cities, such as New Orleans and Lake Charles, Louisiana, from eastern Asia after World War II by way of infested wooden cargo crates and pallets (La Fage 1987). In the continental United States, the first specimen of the Formosan subterranean termite was collected in Charleston, South Carolina in 1957 (Su 2003), but it was not positively identified until 1969.The Formosan subterranean termite was first identified in Houston, Texas in 1966 (Beal 1987). Documentation of infestations followed in New Orleans and Lake Charles, Louisiana and Galveston, Texas (La Fage 1987). In New Orleans, Formosan subterranean termite populations are well-established in the metro area. This species has replaced the native subterranean termite species as the primary structural pest in the greater New Orleans area.

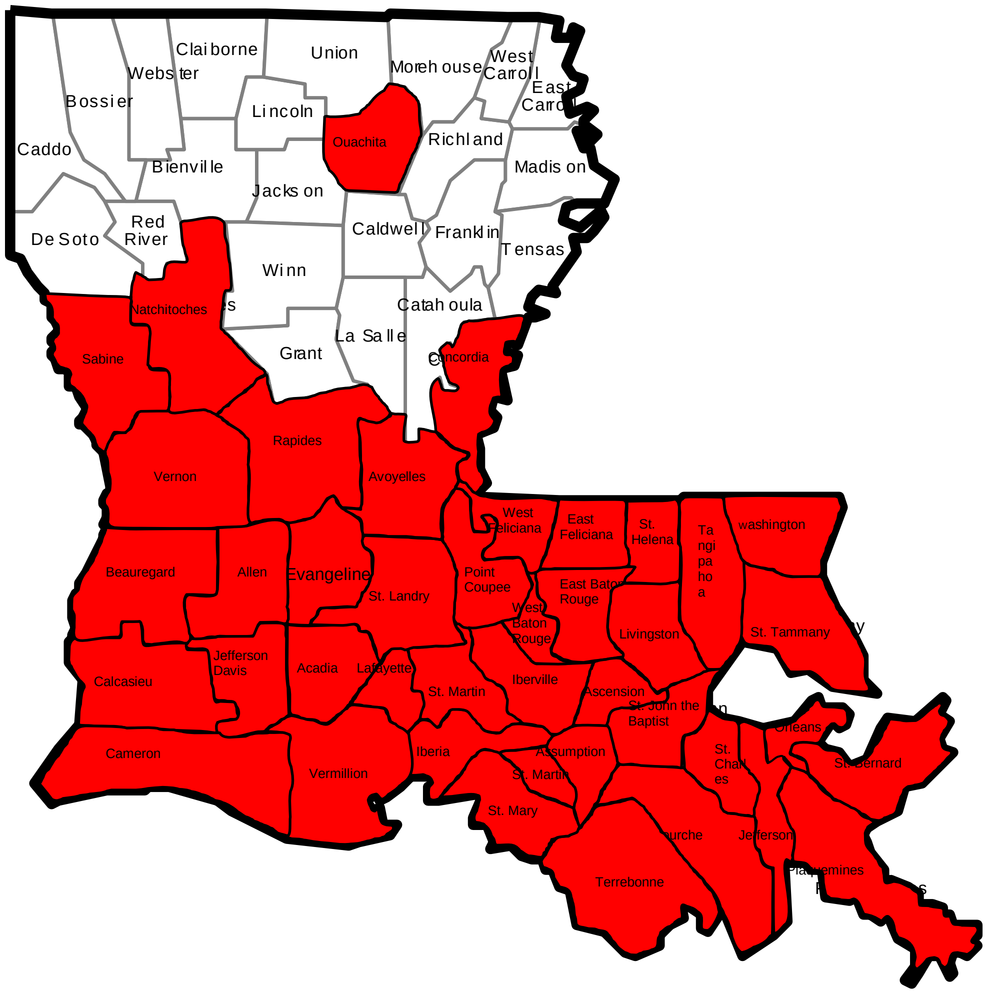
Worldwide, the Formosan subterranean termite is located in temperate and subtropical regions (Su 2003). This species' distribution is limited by its temperature and humidity requirements. Populations of Formosan subterranean termites are typically located within the global area 35° north and south of the equator (Su and Tamashiro 1987).



Worldwide, Formosan subterranean termite populations are established throughout China, Taiwan, Japan, Midway, Hawaii, South Africa, and in multiple locations within the continental United States. Currently, established populations of Formosan subterranean termites have been reported in the states of Texas, Florida, California, Mississippi, Alabama, Tennessee, North Carolina, South Carolina, Georgia, and Louisiana (Su and Tamashiro 1987, Scheffrahn et al. 2001, Woodson et al. 2001).

Although the Formosan subterranean termite disperses naturally through their seasonal flights, the primary method of range expansion is transport of infested materials (La Fage 1987, Scheffrahn et al. 2001, Messenger et al. 2002, Su 2003). After initial introduction into shipping ports, Formosan subterranean termite populations are often moved further inland by human transport.

One well-documented example of this is Louisiana, where only two established infestations within the state were known in 1966: one in Lake Charles, the other in New Orleans (La Fage 1987). A survey throughout Louisiana from 1999 to 2001 showed that the Formosan subterranean termite had been successfully established in the following parishes within the state: Orleans, Calcasieu, Jefferson, La Fourche, St. Tammany, Lafayette, East Baton Rouge, Ascension, St. Charles, Assumption, Terrebonne, St. Bernard, Plaquemines, Iberia, Vermillion, St. Landry, Sabine, Ouachita, Acadia, and St. Mary (Messenger et al. 2002). As recently as 2006, the Formosan subterranean termite distribution in Louisiana had further increased with established populations identified in five parishes where Formosan subterranean termites had not been previously documented: Allen, Beauregard, Iberville, Pointe Coupee, and St. John the Baptist (Brown et al. 2007). Yet ongoing survey research has shown that there are now Formosan subterranean termite infestations occurring in the following Louisiana parishes: Avoyelles, Cameron, Concordia, Jefferson Davis, Livingston, Evangeline, Rapides, St. James, Tangipahoa, Vernon, Washington, and West Baton Rouge.



Formosan subterranean termite colonies can cause millions of dollars worth of damage each year in New Orleans (Lax and Osbrink 2003). The extensive damage caused by Formosan subterranean termite colonies can not be attributed to individuals within the colony consuming a greater amount of wood than those of native subterranean termite species (Su and La Fage 1984). The destructive nature is due, instead, to the fact that Formosan subterranean colonies are more aggressive and contain more individuals than native U.S. species. It has been estimated that Formosan subterranean termite colonies can consist of one to four million foraging termites (Su et al. 1984), nearly 10 times the size of a native subterranean termite colony. Colonies are capable of producing foraging galleries that extend over 300 feet in length and connect multiple feeding sites (King and Spink 1969).

Subterranean termites are social insects with a complex life cycle. They are eusocial in that they exhibit parental care, there are overlapping generations within the colony, and there is a division of labor, or caste system, within the colony. Individuals of multiple castes serve a different function necessary for the survival of the colony. Subterranean termite castes include primary reproductives, replacement and supplementary reproductives, workers, soldiers, nymphs, and larvae (Imms 1931, Edwards and Mill 1986, Lainé and Wright 2003). Each caste contains both male and female individuals (Imms 1931).

The pair of primary reproductives, queen and kin, will mate throughout their lifetimes (Imms 1931). The king's primary function is to mate with the queen, and the queen's primary function is to produce new members of the colony (Edwards and Mill 1986, Imms 1931). In a mature colony, the queen can lay up to 1,000 eggs per day. Replacement reproductives are produced if one or both of the primary reproductives die or are isolated from the colony. A colony may contain a single or multiple reproducing pair(s).

The worker caste comprises the highest proportion of individuals within the colony. Their functions are to forage, feed members of dependent castes, and tend to eggs, newly hatched larvae, and reproductives (Imms 1931, Edwards and Mill 1986). Approximately 10% of individuals within a *C. formosanus* colony are soldiers (Lax and Osbrink 2003). The soldier caste's primary function is to defend the colony against invaders and predators. Their defense mechanisms include large protruding mandibles and a white glue-like defensive secretion exuded from their head. Some individuals will molt to form nymphs in a mature colony. This caste can differentiate into winged reproductives, or alates, replacement reproductives, or supplemental reproductives (Imms 1931). A mature *C. formosanus* colony may contain millions of individual termites. To accommodate the ever increasing population, the nest chambers and gallery systems are expanded.

Control of subterranean termites begins with detection, proper identification of the termite species, and an understanding of the extent of the problem (La Fage 1987). Subterranean termites are cryptic insects that reside underground, inside trees, and remain hidden within walls of buildings (Lax and Osbrink 2003). Within structures, it is difficult to detect a *C. formosanus* infestation until mud tubes or reproductive dispersal flights are observed.

Preventative and remedial control of *C. formosanus* infestations may include the use of liquid termiticides applied to the soil, physical barriers, or monitoring and baiting strategies. Liquid termiticides applied to the soil as a barrier has been the primary method of protecting structures from termite damage for the past 60 years (Su 2003). Liquid termiticides are used as soil barriers, and can either be repellent or non-repellent (Lax and Osbrink 2003). These termiticides are applied beneath the soil surface around buildings to protect them from soil-borne subterranean termites (Su and Scheffrahn 1990).

Physical barriers may be used as preventative measures. One example of this is stainless steel mesh barriers that can be installed prior to construction and serve as a horizontal barrier against termite infestation (Lenz and Runko 1994). Another barrier that can be applied prior to construction is an insecticide-impregnated polymer film that is installed on top of treated soil before the structural foundation is poured (Su et al. 2004). Uniform sized soil particles are another type of physical barrier. These soil particles are too large to be displaced by termites but are also small enough to prevent termites from traveling between them (Ebeling and Pence 1957).

Baiting technology involves placing in-ground monitoring stations that contain a cellulose material in the soil at regular intervals along the perimeter of the structure. These stations are checked at regular time intervals for foraging termites. Once termites are observed in a monitoring station, the cellulose resource is replaced with a substrate that contains active ingredient. However, there are commercially available baits that eliminate the pre-baiting period by initially installing in-ground stations that contain active ingredient. Regardless of the exact protocol designed by the bait manufacturers, the method by which the bait is distributed remains the same. That is, individual termites consume the bait and share it with other individuals within the colony through feeding and grooming behaviors, distributing the bait and eliminating the colony.

References

Beal, R. H. 1987. Introduction of *Coptotermes formosanus* Shiraki to the continental United States, pp. 48-52. In M. Tamashiro and N.-Y. Su [eds.], Biology and Control of the Formosan Subterranean Termite. College of Trop. Agr. Human Resources, Univ. of Hawaii, Honolulu.

Brown, K. S., B. P. Yokum, C. Riegel, and M. K. Carroll. 2007. New parish records of *Coptotermes formosanus* (Isoptera: Rhinotermitidae) in Louisiana. Florida Entomol. 90: 570-572.

Ebeling, W. and R.J. Pence. 1957. Relation of particle size to the penetration of subterranean termites through barriers of sand or cinders. J. Econ. Entomol. 50: 690-692.

Edwards, R. and A. E. Mill. 1986. Termites in Buildings. Their biology and control. The Rentokil Library, Rentokil Ltd, East Grinstead, UK pp. 261.

Imms, A. D. 1931. Social Behaviour in Insects. G. R. de Beer [ed.] Methuen's Monographs on Biological Subjects. London.

King, E. G. and W. T. Spink. 1969. Foraging galleries of the Formosan subterranean termite, *Coptotermes formosanus*, in Louisiana. Ann. Entomol. Soc. Am. 62: 536-542.

La Fage, J. P. 1987. Practical considerations of the Formosan subterranean termite in Louisiana: A 30-year old problem, pp. 37-42. In M. Tamashiro and N.-Y. Su [eds.], Biology and Control of the Formosan Subterranean Termite. College of Trop. Agr. Human Resources, Univ. of Hawaii, Honolulu.

Lainé, L.V. and D.J. Wright. 2003. The life cycle of *Reticulitermes* spp. (Isoptera: Rhinotermitidae): what do we know? Bull. Entomol. Res. 93: 267-378.

Lax, A. R. and W. L. A. Osbrink. 2003. United States Department of Agriculture-Agriculture Research Service research on targeted management of the Formosan subterranean termite *Coptotermes formosanus* Shiraki (Isoptera: Rhinotermitidae). Pest Manag. Sci. 59: 788-800.

Lenz, M. and S. Runko. 1994. Protection of buildings, other structures and materials in ground contact from attach by subterranean termites (Isoptera) with a physical barrier – a fine mesh of high grade stainless steel. Sociobiology. 24: 1-16.

Messenger, M. T., N.-Y. Su, and R. H. Scheffrahn. 2002. Current distribution of the Formosan subterranean termite and other termite species (Isoptera: Rhinotermitidae, Kalotermitidae) in Louisiana. Florida Entomol. 85: 580-587.

Scheffrahn, R. H., N.-Y. Su, J. A. Chase, and B. T. Forschler. 2001. New termite (Isoptera: Kalotermitidae, Rhinotermitidae) records from Georgia. J. Entomol. Sci. 36: 109-113.

Su, N.-Y. 2003. Overview of the global distribution and control of the Formosan subterranean termite. Sociobiology. 41: 7-16.

Su, N.-Y., P. Ban, and R.H. Scheffrahn. 2004. Polyethylene barrier impregnated with lambda-cyhalothrin for exclusion of subterranean termites (Isoptera: Rhinotermitidae) from structures. J. Econ. Entomol. 97: 570-574.

Su, N.-Y, and J. P. La Fage. 1984. Differences in survival and feeding activity among colonies of the Formosan subterranean termite (Isoptera: Rhinotermitidae). Z. angew. Entomol. 97: 134-138.

Su, N.-Y. and R. H. Scheffrahn. 1990. Comparison of eleven soil termiticides against the Formosan subterranean termite and eastern subterranean termite (Isoptera: Rhinotermitidae). J. Econ. Entomol. 83: 1918-1924.

Su, N.-Y., and M. Tamashiro. 1987. An overview of the Formosan subterranean termite in the world, pp. 3-15 In M. Tamashiro and N.-Y. Su [eds.], Biology and Control of the Formosan Subterranean Termite. College of Trop. Agr. Human Resources, Univ. of Hawaii, Honolulu.

Su, N.-Y., M. Tamashiro, J. R. Yates, and M. I. Haverty. 1984. Foraging behavior of the Formosan subterranean termite (Isoptera: Rhinotermitidae). Environ. Entomol. 13: 1466-1470.

Woodson, W. D., B. A. Wiltz, and A. R. Lax. 2001. Current distribution of the Formosan subterranean termite (Isoptera: Rhinotermitidae) in the United States. Sociobiology. 37: 661-671.