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Dating the Damage

Subterranean Termite Infestation and Damage ... How Old Is It?

One of the questions most frequently asked of inspectors, termite technicians, and expert witnesses is how long termite infestation and damage might have been in wood in a structure. This question has led to debates and even litigation on behalf of property owners, which may ultimately bring in pest management professionals either as experts or as defendants. For this Library Update, the termites addressed are pest species of native subterranean termites (*Reticulitermes spp., Heterotermes spp.*); however, many of these conclusions may also apply to Formosan termites (*Coptotermes formosanus*).

Infestation

There is no positive, proven, quantitative method to determine how long termites have infested an area or a structure. It has been proven, and researchers generally agree, that termites will readily infest and, depending on conditions and availability of other food sources, sometimes abandon infested areas. In fact, field observations suggest that an inspector can tap on an area of infested wood, and termites will abandon that area for a certain variable period of time. This periodic infestation is obvious as conditions in the wood vary. In this case, situations hospitable to termite infestation may vary with the seasons and living conditions of humans can cause conditions conducive to infestation to fluctuate. For example, if there is a sprinkler system generating moisture conditions due to improperly adjusted sprinkler heads in a drought, but the moisture condition does not exist in other times, termites may be active in an area but find it inhospitable when the sprinklers are not being used. Also, we know that termites can be very active at certain times of the year, but will not be active in structures at other times of the year, depending on climate and conditions supporting their activity, and in some cases, just the unpredictable nature of termites. In fact, Thorne reports in NPMA's *Biology of Subterranean Termites of the Genus Reticulitermes* that the termite center of activity can change dramatically even from day to day. Thus, the nature of subterranean termites, with their complex system of communication via pheromones, allows infesting and abandoning areas even for no obvious reason. That is specifically why national wood destroying insect infestation reports clearly states that those inspections reports the conditions observed at the time of the inspection only and there is no guarantee of any other condition, either before or after the inspection.

Damage

In some states, damage is essentially defined as evidence of infestation in the wood. There are methods that can be used to date whether damage was present prior to some construction event. Rotramel reported methods to determine relative age of infestation in certain situations. Rotramel went on to discuss the *theoretical* possibility of wood consumption but it is clear that this is theoretical only and cannot be used to validate any estimated age of infestation or damage. Therefore, these methods can be used only as a *relative* dating technique. For one example, if a damaged area had been painted in 1999, and the paint had seeped into and filled tunnels in the damaged wood, it should be obviously clear upon later inspection, that the damage must have been present at the time of painting (*i.e.*, in 1999). Most questions of infestation or damage are not as clear as this example. Forschler reported seasonal variations in detail, including: rainfall patterns, temperature, and even some yet to be discovered termite biology questions which affect termite activity, and thus, feeding.

Below: Even with the best scientific methods, it is impossible to date termite infestation and damage.

There are several assumptions frequently made by experts who try to estimate the amount of damage possible in a structure. First, data can be determined as to how much a typical worker of a typical colony of a typical species may consume in ideal, controlled situations. Then if that is extrapolated to an average size colony, the amount of wood expected to be consumed by that colony may be determined (predicted). This approach is filled with basic scientific inaccuracies. Not all workers consume the same amount, not all colonies feed on the same wood, not all types of wood are consumed at the same rate, and colonies fluctuate in their feeding rates and even populations. Foraging distances and foraging behavior may also play a role as the colony is spread into other areas and is not concentrated in just one area. *(See tables 1 and 2 for more information. All tables are excerpted from* NPCA's Research Report on Subterranean Termites.*)*

Researchers have documented estimated wood consumption rates of various species of subterranean termites

Table 1: Subterranean Termite Foraging Ranges (based on recapture of marked termites)

Species	Maximum Observed Linear Foraging Distance	Estimated Foraging Area	Citation
Coptotermes formosamus	52.1m 110 m 43-115m	 162-3,571 m^2	Li et al. 1976 Lai 1977 Su & Scheffrahn 1988b
Heterotermes aureus	68 m	13-3,316 m^2	Jones 1987, 1990a
Reticulitermes flavipes	48 m, 79.0 m 7.3-70.6 m	266-1091 m^2 18-2,361 m^2 42 m^2	Grace et al. 1989 Su, Ban & Scheffrahn 1993 Forschler 1994
Reticulitermes hageni	12 m	1.3-18.4m^2	Forschler, pers.comm.
Reticulitermes hesperus		25-1,152 m^2	Haagsma & Rust 1995
Reticulitermes virginicus	5 m	0.6-8.3 m^2	Forschler & Ryder 1996

Table 2: Wood Consumption Rates of Subterranean Termites

Species of termite	Species of wood	MG of wood consumed per termite per day	MG of wood consumed per gram of termite per day	Lab Conditions (see below)	Reference
Reticulitermes flavipes	Douglas fir	0.044		A	Smythe & Carter 1970a
	Loblolly pine	0.063		A	Smythe & Carter 1970a
	Ponderosa pine	0.017		A	Smythe & Carter 1970a
	Slash pine	0.089		A	Smythe & Carter 1970a
	Sugar maple	0.074		A	Smythe & Carter 1970a
	Slash pine	.094 - .110		B	Smythe & Williams 1972
	Pinus sp.	.060 - .131		C	Su & Scheffrahn 1993
	Slash pine	0.196	79.64	D	Lenz, Jones & Morton in Lenz 1994
	Slash pine	0.066	26.78	E	Lenz, Jones & Morton in Lenz 1994
Reticulitermes virginicus	Douglas fir	0.02		A	Smythe & Carter 1970a
	Loblolly pine	0.037		A	Smythe & Carter 1970a
	Ponderosa pine	0.004		A	Smythe & Carter 1970a
	Slash pine	0.058		A	Smythe & Carter 1970a
	Sugar maple	0.03		A	Smythe & Carter 1970a
Reticulitermes sp.	Douglas fir	0.008		F	Waller 1988
	Douglas fir	0.035		G	Waller 1988
	Ponderosa pine	0.020		F	Waller 1988
	Ponderosa pine	0.114		G	Waller 1988
	Pine	.110		H	Waller 1996
	Yellow poplar			H	Waller 1996
Coptotermes formosanus	Douglas fir	0.044		A	Smythe & Carter 1970a
	Loblolly pine	0.054		A	Smythe & Carter 1970a
	Ponderosa pine	0.019		A	Smythe & Carter 1970a
	Slash pine	.080		A	Smythe & Carter 1970a
	Sugar maple	.080		A	Smythe & Carter 1970a
	Slash pine	.134 - .140		B	Smythe & Williams 1972
	Slash pine		55.04	I	Su & LaFage 1984a
	Douglas fir		49.2±2.6	J	Su & Tamashiro 1986
	Hemlock		47.1±2.7	J	Su & Tamashiro 1986
	Ponderosa pine		43.3±1.3	J	Su & Tamashiro 1986
	Spruce		43.1±1.8	J	Su & Tamashiro 1986
	Decayed cypress	0.185		K	Waller & LaFage 1987b
	Sound cypres	0.039		K	Waller & LaFage 1987b
	Pine	0.126		K	Waller & LaFage 1987b
	Pinus sp.	.050		L	Delaplane & LaFage 1989a
		0.018		M	Delaplane & LaFage 1989a
		0.054		N	Delaplane & LaFage 1989a
		.010		O	Delaplane & LaFage 1989a
	Pinus sp.	.060 - .131		C	Su & Scheffrahn 1993
	Douglas fir	0.139		P	Cornelius et al. 1997

Laboratory Conditions:

A 100 worker termites at beginning of experiment: 4.5 cm^2 blocks of wood: 26-27°C: 8 weeks
B 100 worker termites at beginning of experiment: 5.8^3 blocks of wood: 30°C: 8 weeks
C 100 worker termites at beginning of experiment: 8cm^3 blocks of wood: 28°C: 3 weeks
D .5 gm of worker termites at beginning of experiment: 192 cm^3 block of wood : 26-27°C: 16 weeks
E .5 gm of worker termites at beginning of experiment: 24 cm^3 block of wood: 26-27°C : 16 weeks
F 200 worker termites at beginning of experiment: 10 cm^3 block of wood: 27°C : 5 weeks
G 200 worker termites at beginning of experiment: 20 cm^3 block of wood:27°C: 5 weeks
H 100 worker termites at beginning of experiment: block size and temperature not given: 5 weeks
I 120 worker termites at beginning of experiment: 5.8 cm^3 block of wood: 29°C:56 days
J 200 worker termites at beginning of experiment: 5.8 cm^3 block of wood: 29°C
K 200 worker termites at beginning of experiment: 4-9 g blocks of wood: 29°C: 27 days
L 1000 worker termites at beginning of experiments: 3.9 cm^3 blocks of wood kept at high moisture: 28.1°C: 17 days
M Same as L but low moisture regime
N 250 worker termites at beginning of experiment: 5.8 cm^3 blocks of wood previously damaged by termites of the same colony: 27.5°C: 3 weeks
O Same as N, but using wood blocks with no previous damage
P 180 worker termites at beginning of experiment: 3.1 cm^3 blocks of wood: 28°C: 20 days

based upon laboratory experiments when a group of termites are introduced into a controlled environment of moist soil/ wood. Thorne reported that the data on these rates is typically developed using "a relatively small number (100-1000) of termite workers removed from their colony and placed in a container with moist soil and /or vermiculite and blocks of wood of known dry weight." Thorne went on to report certain assumptions and possible scientific flaws of this method. This data should never be used for more than reporting possible consumption in ideal situations assuming 100% survival and feeding. Estimating amounts of wood consumed in the real world situation is "prone to high variability and numerous sources of error, and must be viewed as fallacious," as reported by Thorne in an official research report. The most telling information is found in the NPCA Research Report where Thorne states "The unsatisfying but realistic conclusion is that termite feeding rates are highly variable and cannot be reliably used to predict feeding rates in an unstudied population or to retroactively determine the length of time that termites have been in a structure." Forschler also reports "subterranean termite wood consumption rates have not been studied inside structures." *(For more information, see Table 3.)*

This age-old question becomes very complicated and frustrating, with data showing conflicting and confusing information as to termite consumption rates in wood.

Thus, it is not possible to determine, with any scientific accuracy, how long termites have infested a structure and it is impossible to determine conclusively how long any particular termite damage has been present.

References:

Rotramel, G. 2003. "Play the Termite Dating Game," Pest Control Technology, Vol. 31 (No. 9); Sept.

Forschler, B.T, and Thorne, B.L., 1998. NPCA Research Report on Subterranean Termites, NPMA, Dunn Loring, VA. 51 pp.

Table 3: Variables that Affect Studies of Wood Consumption Rates by Termites

VARIABLE	**EXAMPLE REFERECE(S)**
I. TERMITES:	
• Species	Smythe & Carter 1970a, b; Su & Scheffrahn 1993
• Size of individuals	Su & LaFage 1984b, Su & Tamashiro 1986
• Survivorship during the course of the experiment	Smythe & Williams 1972
II. EXPERIMENTAL CONDITIONS:	
• Temperature, humidity (and season in field studies)	Smythe & Williams 1972; Haverty et al. 1974; Forschler 1996
• Number of nutritionally dependent individuals (soldiers, reproductives) in the experimental arena	Su & LaFage 1987
• Force feed (no choice of wood) or variety of woods offered	Esenther 1977
III. WOOD:	
• Species	Smythe & Carter 1970a, b; Su & Tamashiro 1986
• Stage and type of decay	LaFage & Nutting 1978; Waller & LaFage 1987
• Source of wood (e.g. heartwood, sapwood, sawdust)	Smythe & Carter 1970a,b
• Size of wood block(s) relative to the number of workers	Waller 1988; Lenz, Jones & Morton in Lenz 1994
• Moisture content of wood	Delaplane & LaFage 1989a
• Occurrence or absence of previous feeding by termites from the same colony	Delaplane & LaFage 1989a