

14.2 Termites—Greenhouse Gases

14.2.1 General¹⁻²

Termites inhabit many different ecological regions, but they are concentrated primarily in tropical grasslands and forests. Symbiotic micro-organisms in the digestive tracts of termites (flagellate protozoa in lower termites and bacteria in higher termites) produce methane (CH₄). Estimates of the contribution to the global budget of CH₄ from termites vary widely, from negligible up to 15 percent.

Termite CH₄ emissions estimates vary for several reasons. Researchers have taken different approaches to approximating the number of termites per area for different ecological regions (e.g., cultivated land, temperate grassland, tropical forest) and different species. In addition, the total area per ecological region is not universally agreed upon, and not all of the area in an ecological region is necessarily capable of supporting termites. For example, cultivated land in Europe and Canada is located in a climatic zone where termites cannot survive. Some researchers have tried to estimate the percentage of each region capable of supporting termites while others have conservatively assumed that all of the area of a given ecological region can support termites. Finally, the contributions to atmospheric CH₄ from many other related CH₄ sources and sinks associated with termite populations (i. e., tropical soils) are not well understood.

14.2.2 Emissions³⁻⁴

The only pollutant of concern from termite activity is CH₄. Emissions of CH₄ from termites can be approximated by an emission factor derived from laboratory test data. Applying these data to field estimates of termite population to obtain a realistic, large-scale value for CH₄ emissions is suspect, but an order-of-magnitude approximation of CH₄ emissions can be made. Termite activity also results in the production of carbon dioxide (CO₂). These CO₂ emissions are part of the regular carbon cycle, and as such should not be included in a greenhouse gas emissions inventory.

Table 14.2-1 reports typical termite densities per ecological region, and Table 14.2-2 provides the CH₄ emission factors for species typical to each ecological region.

A critical data gap currently exists in determining the activity rate for these emission factors (which are given in units of mass of CH₄ per mass of termite). Estimates of termites per acre are given in Table 14.2-1, but converting the number of termites into a usable mass is difficult. If the species of termite is known or can be determined, then the number of termites or the number of termite nests can be converted into a mass of termites. If the species is not known for a particular area, then a typical value must be used that is representative of the appropriate ecological region. Reference 4 provided information on termite density for various North American species, with an average density of 4.86×10^{-6} lb/worker termite.

An example calculation to estimate annual emissions from termites on 5,000 acres of cultivated land is as follows:

$$\begin{aligned}
 & 5000 \text{ acres} * \frac{11.38 \times 10^6 \text{ termites}}{\text{acre}} = 5.69 \times 10^{10} \text{ termites} \\
 & 5.69 \times 10^{10} \text{ termites} * \frac{4.86 \times 10^{-6} \text{ lb}}{\text{termite}} * \frac{1.8 \times 10^{-3} \text{ lb CH}_4}{1000 \text{ lb termite}} * \frac{1}{\text{hr}} * \frac{8760 \text{ hr}}{\text{yr}} \\
 & = 4360.39 \frac{\text{lb CH}_4}{\text{yr}}
 \end{aligned}$$

To convert pounds to kilograms, multiply by 0.454.

Table 14.2-1. TYPICAL TERMITE DENSITIES PER ECOLOGICAL REGION^a

Ecological Region	10 ⁶ Termites per Acre
Tropical wet forest	4.05
Tropical moist forest	18.01
Tropical dry forest	12.80
Temperate	2.43
Wood/shrub land	1.74
Wet savanna	17.81
Dry savanna	3.48
Temperate grassland	8.66
Cultivated land	11.38
Desert scrub	0.93
Clearing and burning	27.62

^a Reference 3.

Table 14.2-2. METHANE EMISSION FACTORS FOR TERMITES^a

EMISSION FACTOR RATING: E

Termite Species (Ecological Region)	Methane Emissions (lb CH ₄ /1000 lb termite/hr)
Tropical forest	4.2 E-03
Temperate forest	1.8 E-03
Savanna	8.0 E-03
Temperate grassland	1.8 E-03
Cultivated land	1.8 E-03
Desert scrub	1.0 E-03

^a References 5 and 6. Reference 7 suggests the following seasonal variation based on studies of the species *Coptotermes lacteus*:

Spring - 22%
Summer - 49%
Fall - 21%
Winter - 8%

References For Section 14.2

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3. P. R. Zimmerman, *et al.*, "Termites: A Potentially Large Source Of Atmospheric Methane, Carbon Dioxide, And Molecular Hydrogen", *Science*, 218(5):563-565, Nov. 1982.
4. K. Krishna and F. M. Weesner, *Biology Of Termites, Volume I*, Academic Press, New York, 1969.
5. Written Communication from M. Saegar, SAIC, to Lee Beck, Project Officer, U. S. Environmental Protection Agency, regarding *Summary Of Data Gaps Associated With County-Specific Estimates Of CH₄ Emissions*, July 6, 1992.
6. P. J. Frasser, *et al.*, "Termites And Global Methane — Another Assessment", *Journal Of Atmospheric Chemistry*, 4:295-310, 1986.
7. T. M. Lynch, *Compilation Of Global Methane Emissions Data, Draft Report*, Alliance Tech. Corp. for U. S. Environmental Protection Agency, Nov. 1991.