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**The importance of termites (Isoptera) for the recycling of  
herbivore dung in tropical ecosystems: a review**

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**by**

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**Abstract.** While the key role of termites in the decomposition of litter in the tropics  
has been acknowledged for a long time, much less insight exists in their importance  
50 for the recycling of dung of primary consumers, especially herbivores. A review of  
published studies shows that a diverse group of termites (at least 126 species) has  
been reported to feed on a wide range of mammalian dung (18 species).  
Predominantly, wood-feeding and polyphagous wood-litter feeding species were  
found to feed also substantially on dung. Moreover, we found that termites can  
55 quickly remove large amounts of mammalian dung, especially in the dry season, when  
on average about 1/3-rd of the dung deposited in a given habitat is removed by  
termites within one month (with the highest rates observed in savannas). No  
distinctive preference for mammalian dung over other organic food sources was  
observed for fungus-growing termites (Macrotermitidae), whereas the majority of the  
60 studied non-fungus growing taxa prefer dung over alternative food items. As termites  
bring large quantities of dung below the soil surface, with associated substantial  
pedoturbation and nutrient enrichment of soils, dung feeding by termites appears to be  
a previously underestimated process that is important in order to understand the  
functioning of tropical ecosystems.

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## **INTRODUCTION**

Termites are widely distributed throughout the tropical and subtropical regions  
of the world, with the highest diversity found in tropical forests (Eggleton, 2000).

70 Until the early 1970's approximately 1900 living and fossil species of termites had  
been described (Lee & Wood, 1971) and a constant flow of first descriptions is still  
increasing this number significantly. Termites (taxon-dependent) act as herbivores as  
well as decomposers, feeding on a wide range of living, dead or decaying plant  
materials (Adamson, 1943; Noirot & Noirot-Timothee, 1969; Lee & Wood, 1971;  
75 Wood, 1976, 1978; Bignell & Eggleton, 2000; Traniello & Leuthold, 2000), including  
the consumption and turnover of large volumes of soil rich in organic matter and  
fungi. These feeding habits make termites important ecosystem engineers resulting in  
the long-term modification of physical soil properties such as texture, water  
infiltration rates and nutrient contents at various spatial scales (e.g. Dangerfield et al.  
80 1998).

Previous overviews of the food and feeding habits of termites either only list  
mammalian dung as just one possible food item (Lee & Wood, 1971; Wood, 1976,  
1978; Bignell & Eggleton, 2000; Traniello & Leuthold, 2000) or even do not mention  
mammalian dung as a food item of termites at all (Adamson, 1943; Noirot & Noirot-  
85 Timothee, 1969). Only one older paper focuses on the utilization of mammalian dung  
by termites (Ferrar & Watson, 1970), but is restricted to data from the Australian  
region. It does not include the more recent work on the subject, and does not address  
the ecosystem consequences of dung feeding by termites (Ferrar & Watson, 1970).  
The lack of attention for the role of termites as dung feeders has been in strong  
90 contrast to the attention that has been paid to dung beetles in the comminution and  
decomposition of herbivore dung, emphasizing the importance of the latter group for  
nutrient cycling (e.g. Hanski & Cambefort, 1991). So far, the question to what extent  
and which species of termites consume mammalian dung and whether termites might  
fulfil a similar ecosystem role as dung beetles, has remained largely unanswered. In

95 this paper we therefore review the existing literature on the processing of herbivore  
dung by termites, from both the termite autecological perspective, as well as its  
ecosystem consequences.

## THE AUTECOLOGICAL PERSPECTIVE

**Consumption of mammalian dung.** We identified 24 studies, dating between  
100 1955 and 2004, that contain detailed data on the consumption of mammalian dung by  
termites (Appendix). These studies report in total 126 taxa of termites to feed on  
dung. This number represents a conservative count and is most likely an  
underestimation: studies reporting a termite genus to utilize dung with no species  
specification were counted only once and omitted completely from the count if  
105 another publication provided a species-specific record of the same genus.  
Representatives of the families Mastotermitidae, Rhinotermitidae and predominantly  
Termitidae are involved in the removal of dung. In our list the genus *Amitermes*,  
family Termitidae, is remarkable, in that at least 35 species have been reported to use  
dung as a food source. This observation might be explained by the high diversity  
110 (Scheffrahn et al., 1999) as well as the polyphagous feeding style and tropicopolitan  
distribution of this genus (Eggleton, 2000), which is most diverse in semi-arid habitats  
(Scheffrahn & Su, 1987).

The majority of the findings were extracted from surveys of termite diversity,  
from a smaller number of field (using mostly cattle-dung/cattle-manure, exceptionally  
115 elephant dung) and one single laboratory experiment, which provided only descriptive  
data (Skaife, 1955). Incidents where termites foraged on mammalian dung were  
reported from around the globe: Africa, Asia, Australia and North-/Central-/South-  
America. Most observations were made in Australia and Africa, potentially mirroring

a skewed emphasis to preferentially study feeding habits of termites in grass- and  
120 bush-lands on these continents.

Across studies, termites were observed to feed on dung of in total 18  
mammalian species: black rhinoceros (*Diceros bicornis*), African buffalo (*Syncerus  
caffer*), cattle (*Bos taurus*), camel (*Camelus* sp.), dikdik (*Madoqua* sp.), donkey  
(*Equus asinus asinus*), African elephant (*Loxodonta africana*), goat (*Capra aegagrus  
125 hircus*), horse (*Equus caballus*), hyrax (Hyracoidea), impala (*Aepyceros melampus*),  
kudu (*Tragelaphus* sp.), kangaroo/wallaby (Macropodidae), sheep (*Ovis aries*), duiker  
(Cephalophinae), springbok (*Antidorcas marsupialis*), wombat (Vombatidae) and  
zebra (*Equus quagga* ssp). We found no references for a clear specialization where  
particular termite species would feed mainly on the dung of one particular mammalian  
130 herbivore species. When we analyzed the collective records with regard to feeding-  
types, we found that predominantly wood-feeding (42 species = 39%) as well as  
polyphagous wood-litter feeding termite species (27 = 25%) also forage on  
mammalian dung. In comparison to that, 17 litter- (= 16%) and 22 (= 20%) soil-  
feeding termite species were documented to show the same behavior. Given that, we  
135 may hypothesize that the consumption of mammalian dung by termites is of more  
than mere incidental importance. The question arises, how termites manage to locate  
this spatial and temporal heterogeneously distributed food source?

**Locating dung.** Johnson & Whitford (1975) studied the foraging behavior of  
unidentified subterranean termites in the Chihuahuan desert and found that *Yucca  
140 elata* logs and cattle dung, which provided large surface area contact with the soil,  
were preferred over small twigs and surface litter. They conclude that the modified  
environment under a large object on the soil surface (e.g. increased moisture content)  
is a necessary factor in food suitability, at least for subterranean termites. Ettershank

et al. (1980) conducted baiting field experiments to see if this modified environment  
145 is also used for locating the food. They conclude that desert subterranean termites  
locate relatively large size surface food such as cattle dung and *Yucca* sp. logs by  
sensing the thermal shadows cast by such items. A next question is whether dung is  
particularly attractive to termites from a nutritional perspective, or whether it is just an  
accumulation of organic matter?

150       **Nutrition.** As Higashi et al. (1992) outlined, as termites generally feed on  
dead plant material that has a carbon to nitrogen ratio much higher than their own  
tissues', they have to balance their C and N inputs. The same authors list two classes  
of such C-N balancing mechanisms: adding N to inputs or selectively eliminating C,  
both achieved with the aid of microbial symbionts. But the lower the C/N ratio of the  
155 diet, the less urgently this balancing is needed. Matsumoto (1976) reports C/N ratios  
of 4 to 12 for termite tissues, whereas fresh dead wood has C/N ratios as high as 350  
to 1000 (LaFage & Nutting, 1978). For comparison, Ouédraogo et al. (2004) provide  
data on the C/N ratio of the baits they presented to termites: *Andropogon* straw = 153  
(0.32% N), cattle dung = 40 (0.95% N), maize straw = 59 (0.77% N). Accordingly, at  
160 least the cattle dung provided to the termites in this study has a much more favorable  
C/N ratio than the alternative food items and might, therefore, be attractive to  
termites. In spite of this, and the clearly increased phosphorous levels of the used  
cattle dung (1.06% vs. 0.03% in *Andropogon* straw and 0.18% in maize straw), the  
involved soil macrofauna preferentially removed the straw over the cattle dung (Table  
165 2, later discussion). This may mean that the symbiotic opportunities of termites that  
allow them to compensate for very low food quality simply overrule the need to be  
highly selective in food selection from a C/N ratio perspective. Despite the various

biochemical processes involved, this may accordingly hold true for both – endo- and ectosymbiotic (fungus-growing) termites.

170           Alternatively, or additionally, it might be that the physical parameters bulk density, texture and spatial location of dung make this food source attractive to termites. Seen in comparison to the alternatives, such as standing, dead grass, dung  
175           pats are an easily available local accumulation of litter and organic matter, aggregated by large herbivores. Termites might simply benefit energetically by exploiting dung  
175           pats with a comparable high mass per volume ratio, instead of feeding on grass litter that needs to be collected over a wider spatial range in a more unfavorable  
microclimate. Moreover, the mammalian herbivores and their endosymbionts mechanically (fragmentation) and biochemically ‘preprocessed’ the plant materials and in this way may have facilitated the further utilization by termites.

#### 180   **THE ECOSYSTEM PERSPECTIVE**

          Dung deposited naturally on the soil surface by mammalian herbivores needs to be broken down and eventually incorporated into the soil layer to reenter the nutrient cycle. It has been suggested for a long time (e.g. Adamson, 1943), that termites are of crucial importance to the fertility of tropical soils and the productivity  
185           of ecosystems. Besides that termites promote aeration, drainage and penetration of roots, as well as contribute to pedoturbation via their epigeal lifestyle, termites accelerate the formation of humus and the cycling of mineral elements by consuming  
dead wood and other plant remains (Adamson, 1943). The question arises, whether the comminution of mammalian dung by termites is not only of autecological  
190           importance but also impacts the functioning of the ecosystem, i.e. the nutrient cycling dynamics, and if so how these effects may be qualified and quantified.

**Removal rates.** The results of five studies reporting dung removal rates of termites as measured in field experiments are summarized (Table 1). Since the removal rates, as reported in the original publications, were measured over different  
195 time intervals, we standardized them to: % dung removed/month. The five studies report that termites removed between 12-57% of available dung within one month. Overall, higher removal rates were measured in the dry than in the wet season (Coe, 1977; Omaliko, 1981; Whitford et al., 1982; Ouédraogo et al., 2004). Measured removal rates were 12 %/month for a desert, 36-57 %/month in savannas, 31 %/month  
200 in an agricultural field and 12 %/month in a pasture. Despite the low sample size, savannas tend to have the highest removal rates. Over all studies, the average dung removal rate by termites was around 30% per month of the dung placed in a given habitat in the field by experimentators.

**Preferences and seasonality.** Another important aspect is the occurrence of  
205 food preferences and the differentiated role of termites vs. dung beetles. The results shown in Table 1 are quantitative ones reflecting a general, qualitative trend though: higher removal rates are found during the dry season for a given habitat. As mentioned earlier, Ferrar & Watson (1970) also reach the conclusion that termites prefer dry dung pats. One single study (Herrick & Lal, 1996) documents an increased  
210 comminution of cattle dung by *Amitermes beaumonti* and *Hoplotermes* sp. nov. in a Neotropical pasture ecosystem in the wet season. Many authors, e.g. Weir (1971), detected the overall pattern that dung beetles are responsible for the removal and burial of almost all dung during the wet season. This has led various authors to state that dung beetles are generally responsible for nutrient recycling from dung (e.g.  
215 Losey & Vaughan, 2006). It appears that this is however only true for the wet season: since adult dung beetles feed exclusively on the liquid component of the dung by



means of specialized filtering mouthparts (Cambefort, 1991), they rely on the availability of dung with high water content. In addition, some dung beetle species (e.g. *Onthophagus binodis*) produce significantly fewer brood balls under dry soil conditions (Barkhouse & Ridsdill-Smith, 1986). This means that in the dry season termites seem to gain in importance – relative to dung beetles. But dung is not only a temporally but also spatially very heterogeneous resource; it is not permanently available to termites, based on the mobile lifestyle of its producers, while termites are sessile and bound to their nests. This is an important contrast to dung beetles, which are mobile. These factors might be of explanatory nature to the findings regarding food-preferences (dung vs. other, natural items) of termites (Table 2). Overall, termites show no clear, distinct preference for mammalian dung over other plant food items. A very interesting pattern becomes apparent though if the 12 fungus-growing taxa (Macrotermitinae) are compared to the remaining ten species that do not grow fungi: while half of the Macrotermitinae taxa show a preference for the alternative plant food items (50%) or no clear preference at all (33%), the greater part (70%) of the non-fungus-growers prefers dung (Table 2). The finding regarding the fungus-growers is surprising on the one hand, given the advantageous nutritional characteristics of dung as argued earlier. On the other hand, feeding on mammalian dung might be even disadvantageous to a certain extent for termites, especially the Macrotermitinae: about 330 termite species in this subfamily are known to cultivate a specialized fungus, genus *Termitomyces*, for food (Mueller et al., 2005). The nest of a single termite species can have different, but few, symbiotic species (Aanen et al., 2002). Since termite nests provide conditions (high humidity, stable temperature) that favor this required microbial growth (Roy et al., 2006), termite nests also are favorable habitats for entomopathogenic fungi and bacteria, which hypothetically can

be contained in herbivore dung. Social insects are known to show host-mediated behavior such as increased grooming, increased nest cleaning, secretion of antibiotics, dispersal of infected individuals and relocation of the entire colony in order to reduce pathogen transmission (Roy et al., 2006). The finding that fungus-growing termites do not clearly prefer herbivore dung might be therefore an expression of pathogen avoidance. From the fungal symbionts' perspective, it may be more beneficial that termites feed it the same type of organic matter (e.g. a dominant grass) throughout the year, rather than vary greatly the type of food. It might be the case, that termites exploit mammalian dung opportunistically in case it becomes available as a food source to them, but potentially the spatial and temporal heterogeneity of the availability of this food source counteracted the evolutionary development of a distinct behavioral preference for this food source, at least in some groups of termites.

**Impacts on nutrient cycling.** Despite the lack of evidence for a preferential feeding on dung by termites as a whole, support can be found for the concept that the comminution of mammalian dung by termites impacts the ecosystem's functioning via the nutrient cycle dynamics.

Coe (1977) estimates for the Tsavo (East) National Park (Kenya), that during a year termites may remove up to  $8.7 \times 10^3$  kg faeces per  $\text{km}^2$  from the surface of the soil. This equals a nitrogen turnover of about 12 kg/ha/year based on a nitrogen content of 1.39% for fresh elephant dung as reported by Anderson & Coe (1974). This estimation gives a quantitative impression of the role of termites in facilitating the return of nutrients below the soil surface after they passed through the primary consumer (mammalian herbivores) component of the nutrient cycle. Without direct comparable data on the equivalent removal of dung by dung beetles though, the overall, quantitative importance of this process remains elusive. Herrick & Lal (1996)

studied the dung removal by termites associated with the transport of soil, both within the profile and to the soil surface (pedoturbation). They found a strong linear relationship between dung removal and soil accumulation at the original soil surface, with an average of 2.0 g soil accumulated for every gram of dung which was removed. For their Neotropical pasture system, they give the minimum estimate of 2450 kg ha<sup>-1</sup> year<sup>-1</sup> of soil turnover in association with dung produced by two animal units ha<sup>-1</sup> (Herrick & Lal, 1996). Basappa & Rajagopal (1990) examined physical and chemical properties of termite modified soils in India. The results were that the water holding capacity, pH, organic carbon, organic matter, total nitrogen, the cation exchange capacity, as well as the exchangeable cations like calcium, magnesium, potassium and sodium were higher in termite modified soils than in surrounding soils (Basappa & Rajagopal, 1990). Some of these findings (e.g. regarding phosphorous) may be explained by the incorporation of organic matter and left-over dung into the termite modified soil. Similar findings are to be expected for non-dung feeding termites as well. Independent of the actual source of nutrients or the processes underlying the enrichment, termite modified soils are richer in nutrients; nutrients that in turn may facilitate primary productivity. This second process may be temporarily delayed: Weir (1971) used radioactive P<sub>32</sub> to study the removal of dung by termites in Zimbabwe. The author could document that termites (unknown species) consumed the dung, but no radioactivity was detected in the adjacent vegetation during five months of the dry season in which the measurements were taken. Thus, the removal of nutrients by termites to their mounds did not result in this material becoming accessible to plants during the dry season (Weir, 1971). This process might be delayed until the point in time when a given termite colony dies and the mound or the nest eventually is subject to erosion; e.g. shown by Coventry et al. (1988).

Furthermore, studies document that the consumption of mammalian dung influences the spatial distribution of termites. Gould et al. (2001) found *Amitermes beaumonti* to be more abundant in the stratum ranging from 0-3.5 cm below their  
295 cattle dung baits they used in Costa Rica (vs. the 3.5-7.0 cm stratum). Exactly the opposite pattern was found in control areas, indicating that at least this termite species adjusts its subterranean foraging behavior according to the accessibility of dung used as a food source. From the mammalian perspective, Coe & Carr (1978) report that blesboks (*Damaliscus dorcas phillipsi*) appear to deliberately place their middens in  
300 the vicinity of mounds of harvester termites (*Trinervitermes trinervoides*). They hypothesize that this is due either to the fact that termite mounds provide a spot of bare ground and therefore an increased visibility helping to detect predators and/or that blesboks are attracted to the mounds due to the increased foraging quality of the surrounding vegetation. The later reasoning could therefore be of the nature of a  
305 positive feedback loop involving foraging behavior of termites and mammalian herbivores, but it awaits further clarification.

With respect to the overall nutrient cycling dynamics, termites may be seen as the crucial connective component between the dung producing herbivores and the microbial decomposers in savannas by further fragmenting, and maybe even more  
310 important, spatially redistributing the dung particles. From temperate regions it is known that invertebrates, such as earthworms, are of critical importance: they comminute and ingest the plant debris, resulting in the incorporation of organic matter into the soil, as well as a significant increase in its surface area, but little chemical change (Burgess, 1967). If herbivore dung is regarded as partially decomposed plant  
315 material, it becomes apparent that termites and earthworms fulfil comparable ecological roles in these ecosystem dynamics. The major difference between termites

and other invertebrate decomposers is that – especially in savannas – considerable quantities of plant materials are consumed by wood-, grass- and fresh litter-feeding termites before and not after it has been attacked by saprophytic micro-organisms (Wood, 1976). In the case of herbivore dung, this distinction does not hold anymore, since the plant material already has been attacked by the herbivores' own gut-endosymbionts. In contrast to the equivalent feeding guild of earthworms in temperate regions though, mound-building, fungus-growing termites (e.g. *Macrotermes*) are capable of engineering their own soil microclimate in order to facilitate the decomposition of plant materials by their symbiotic fungi.

### **CONCLUDING REMARKS**

From an autecological point of view, we found a previously underestimated diversity of termite taxa to feed on a wide range of mammalian dung.

From the ecosystem perspective, we conclude that termites remove substantial quantities of mammalian dung and associated soil, over relatively short times and preferably in the dry season. The foraging on dung appears to be of only opportunistic importance to termites. No distinctive preference for mammalian dung could be detected for termites as a whole group and for fungus-growers in particular, but was found for no-fungus-growing termites. By removing large quantities of dung from above to below the soil surface, by being responsible for substantial pedoturbation and nutrient enrichment of soils as well as by causing changes in the spatial distribution of termites and even the mammalian dung producers themselves, this feeding behavior appears to be of great importance on the ecosystem level.

Coming back to our initial question whether termites, by foraging on mammalian dung, might fulfil a comparable ecological role as dung beetles do in the context of nutrient cycling dynamics, we can conclude that the currently existing body

of literature supports qualitatively the view that these two feeding guilds are both of ecological significance, but no sufficient, quantitative information exists to ultimately answer this question at the current point in time.

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TABLE 1. Dung removal rates of termites measured in field experiments. Standardized removal rates were computed assuming a linear removal-time relation as e.g. found by Coe (1970). Abbreviations: d = days, m = months.

Original removal rate	System	Standardized removal rate (% dung removed/month)	Reference
100% / 80-85 d	savanna, Kenya dry season elephant dung <i>Odontotermes</i> sp. <i>Microtermes</i> sp.	ca. 36 %/m	Coe 1977
80-85% / 5-9 m	pasture, Costa Rica dry + wet season cattle dung <i>Amitermes beaumontii</i> <i>Hoplotermes</i> sp. nov.	ca. 12 %/m	Herrick & Lal 1996
80% / 42 d (dry) 50% / 42 d (wet)	derived savanna, Nigeria dry + wet season cattle dung unknown termite sp.	ca. 57 %/m (dry) ca. 36 %/m (wet)	Omaliko 1981
92% / 3 m	sorghum field, Burkina Faso wet season cattle dung <i>Macrotermes</i> sp. <i>Trinervitermes</i> sp.	ca. 31 %/m	Ouédraogo et al. 2004
42.2% / 3 ½ m	Chihuahuan desert, USA cattle dung <i>Gnathamitermes tubiformans</i> <i>Amitermes wheeleri</i>	ca. 12 %/m	Whitford et al. 1982

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TABLE 2. Food preferences of termites with respect to the consumption of mammalian dung. Abbreviations: ca = cattle dung, el = elephant dung, ho = horse dung, to = tortoise droppings, M = measurement taken.

Food Preference	Species	Reference
el dung = "other" dung=dead roots	<i>Amitermes sciangallorum</i>	Buxton 1981
grass=ground wood>el dung	<i>Macrotermes subhyalinus</i>	M: semi-quantitative
el dung=grass	<i>Odontotermes badius</i>	(minor vs. major consumption)
el dung=grass =ground wood>"other" dung	<i>Odontotermes zambesiensis</i>	
el dung=grass=ground wood>"other" dung	<i>Odontotermes mediocris</i>	
ground wood>el dung	<i>Microtermes allaudanus</i>	
ground wood>el dung	<i>Synacanthotermes zanzibarensis</i>	
el dung>litter	<i>Odontotermes</i> sp. <i>Microtermes</i> sp.	Coe 1977 M: # plots with termites
woody litter>mammalian dung	<i>Macrotermes michaelsoni</i> <i>Microtermes</i> sp.	Dangerfield & Schuurman 2000 M: descriptive
cattle dung>mesquite wood	<i>Gnathamitermes tubiformans</i> <i>Amitermes wheeleri</i>	Ettershank et al. 1980 M: # termite attack holes
cattle dung> control (litter etc.)	<i>Amitermes beaumonti</i> <i>Hoplotermes</i> sp. nov.	Gould et al. 2001 M: individuals/plot
cattle dung> control (litter etc.)	<i>Amitermes beaumonti</i> <i>Hoplotermes</i> sp. nov.	Herrick & Lal 1996 M: termites/l of soil
cattle dung>litter <i>Yucca</i> wood>litter	unknown	Johnson & Whitford 1975 M: foraging groups/source/ha
<i>Andropogon</i> or maize straw >cattle dung	<i>Macrotermes</i> sp. <i>Trinervitermes</i> sp.	Ouédraogo 2004 M: individuals/bait
millet (canes or ground)>cattle manure millet (canes)>manure>ground millet	<i>Macrotermes subhyalinus</i> <i>Odonotermes nilensis</i>	Rouland et al. 2003 M: mass of soil sheeting
litter (Restionaceae)>ca,el,ho,to dung	<i>Amitermes hastatus</i>	Skaife 1955 M: descriptive (lab)

## APPENDIX

505 Termites reported to forage on dung. Dung consumed: br = black rhinoceros, bu = buffalo, ca = cattle, cam = camel, di = dikdik, do = donkey, el = elephant, em = emu, go = goat, ho = horse, hy = hyrax, im = impala, ku = kudu, kw = kangaroo/wallaby, sh = sheep, sm = small buck, sp = springbok, to = tortoise, wo = wombat, ze = zebra; Country: Au = Australia, BF = Burkina Faso, Bo = Botswana, Br = Brazil, CR = Costa Rica, In = India, Ke = Kenya, Na = Namibia, SA = South Africa, Se = Senegal, Tz = Tanzania, USA, Zi = Zimbabwe; Habitat: AF = agricultural field, Bu = bush land/ wood land, De = desert, Pa = pasture, Sa = savanna; Study: Ex = experiment in field, La = laboratory, Su = survey; Other diet: W = wood-feeding, L = litter-feeding, S = soil-feeding.

Taxon	Dung	Country	Habitat	Study	Other Diet	Reference
<b>MASTOTERMITIDAE</b>						
<i>Mastotermes darwiniensis</i>	ca	Au	?	Su	WL	Ferrar&Watson 1970 Gay&Calaby 1970
<b>RHINOTERMITIDAE</b>						
<i>Heterotermes cf. tenuis</i>	ca	Br	Sa	Ex	W	DeSouza 1993
<i>Heterotermes ferox</i>	ca,ho	Au	?	Su	W	Ferrar&Watson 1970
<i>Heterotermes longiceps</i>	ca	Br	Sa	Ex	W	DeSouza 1993
<i>Heterotermes paradoxus</i>	ca,ho	Au	?	Su	W	Ferrar&Watson 1970
<i>Psammotermes allocerus</i>	br,ca, cam,do, el,go, ho,sh, sp,ze	Na Zi	Bu,Sa Bu	Su Su	W W	Coaton&Sheasby 1972 Mitchell 1980
<i>Psammotermes hybostoma</i>	?	?	?	?	?	Harris 1970
<i>Schedorhinotermes actuosus</i>	ca	Au	?	Su	WL	Ferrar&Watson 1970
<i>Schedorhinotermes seclusus</i>	ho	Au	?	Su	W	Ferrar&Watson 1970
<b>TERMITIDAE</b>						
<b>Apicotermatinae</b>						
<i>Anoplotermes</i> spp. a,b	ca	Br	Sa	Ex	S	DeSouza 1993
<i>Grigiotermes</i> sp.	ca	Br	Sa	Ex	S	DeSouza 1993
<i>Hoplotermes</i> sp. nov	ca	CR	Pa	Ex	?	Herrick&Lal 1996 Gould et al. 2001
<i>Ruptitermes</i> spp. a,d	ca	Br	Sa	Ex	S	DeSouza 1993
<b>Macrotermatinae</b>						
<i>Allodontermes</i> sp.	ca,do, el,ho, ku,ze	Na Zi	Bu,Sa Bu,Sa	Su Su	WL WL	Coaton&Sheasby 1972 Mitchell 1980

<i>Ancistrotermes latinotus</i>	ca,el, ku,sm	Zi SA	Bu,Sa	Su Su	WL	Mitchell 1980 Uys 2002
<i>Macrotermes</i> sp.	ca,el	Na	Bu,Sa	Su	WL	Coaton&Sheasby 1972
<i>Macrotermes</i> sp.	ca	BF	AF	Ex	WL	Ouédraogo et al. 2004
<i>Macrotermes falciger</i>	ca,el	Zi	Bu,Sa	Su	WL	Mitchell 1980 Dangerfield&Schuurman 2000, Mitchell 1980
<i>Macrotermes michaelsoni</i>	ca,el	Bo,Zi	Bu,Sa	Su	WL	Buxton 1981, Mitchell 1980
<i>Macrotermes subhyalinus</i>	ca,el	Ke,Zi	Bu,Sa	Su	WL	Rouland et al. 2003
<i>Macrotermes subhyalinus</i>	ca	Se	Sa	Ex	WL	Mitchell 1980
<i>Macrotermes ukuzii</i>	bu,cal,	Zi	Bu,Sa	Su	WL	Coaton&Sheasby 1972
<i>Microtermes</i> sp.	bu,ca,do, el,ho,	Na Ke	Bu,Sa Bu,Sa	Su Ex	W W	Coe 1977 Dangerfield&Schuurman 2000
	ku,sh	Bo Zi	Bu,Sa Bu,Sa	Su Su	W W	Mitchell 1980
<i>Microtermes allaudanus</i>	el	Ke	Bu,Sa	Su	W	Buxton 1981
<i>Odontotermes</i> sp.	ca,do, el,ho, ku,ze	Na Ke	Bu,Sa Bu,Sa	Su Ex	W W	Coaton&Sheasby 1972 Coe 1977
<i>Odontotermes amaniensis</i>	?	Ke	?	Ex	W	Burchard 1989
<i>Odontotermes badius</i>	ca,el	Ke,Zi	Bu,Sa	Su	WL/L	Buxton 1981, Mitchell 1980
<i>Odontotermes boranicus</i>	el	Tz	Bu	Su	W	Kemp 1955
<i>Odontotermes horni</i>	?	In	?	Ex	?	Basappa&Rajagopal 1990
<i>Odontotermes latericius</i>	ca,el	Zi	Bu,Sa	Su	W	Mitchell 1980
<i>Odontotermes mediocris</i>	el	Ke	Bu,Sa	Su	WL	Buxton 1981
<i>Odontotermes nilensis</i>	ca	Se	Sa	Ex	WL	Rouland et al. 2003
<i>Odontotermes obesus</i>	?	In	?	Ex	?	Basappa&Rajagopal 1990
<i>Odontotermes patruus</i>	ca	Tz	Bu	Su	W	Kemp 1955
<i>Odontotermes stercorivorus</i>	?	Ke	?	Ex	W	Burchard 1989
<i>Odontotermes transvaalensis</i>	ca	Zi	Bu,Sa	Su	W	Mitchell 1980
<i>Odontotermes wallonensis</i>	?	In	?	Ex	?	Basappa&Rajagopal 1990
<i>Odontotermes zambesiensis</i>	el	Ke	Bu,Sa	Su	WL	Buxton 1981
<i>Pseudacanthotermes militaris</i>	ca	Zi SA	Bu	Su Su	WL	Mitchell 1980 Uys 2002
<i>Synacanthotermes zanzibarensis</i>	el	Ke	Bu,Sa	Su	W	Buxton 1981
Nasutitermitinae						
<i>Armitermes</i> spp. a,b,c	ca	Br	Sa	Ex	S	DeSouza 1993
<i>Atlantitermes stercophilus</i>	ca	Br	Sa	Ex	S	Constantino&DeSouza1997
<i>Baucaliotermes hainesi</i>	ca	Na	Bu,De,Sa	Su	L	Coaton&Sheasby 1972
<i>Cornitermes</i> sp.	ca	Br	Sa	Ex	W	DeSouza 1993
<i>Diversitermes diversimiles</i>	ca	Br	Sa	Ex	W	DeSouza 1993
<i>Embiratermes heterotypus</i>	ca	Br	Sa	Ex	S	DeSouza 1993
<i>Embiratermes spissus</i>	ca	Br	Sa	Ex	S	DeSouza 1993
<i>Fulleritermes coatoni</i>	ca	Zi SA	Bu,Sa	Su Su	WL	Mitchell 1980 Uys 2002
<i>Labiotermes</i> spp. a,b	ca	Br	Sa	Ex	S	DeSouza 1993
<i>Nasutitermes coxipoensis</i>	ca	Br	Sa	Ex	W	DeSouza 1993
<i>Nasutitermes eucalypti</i>	ca	Au	?	Su	W	Ferrar&Watson 1970
<i>Nasutitermes kemneri</i>	ca	Br	Sa	Ex	W	DeSouza 1993
<i>Nasutitermes kimberleyensis</i>	ca	Au	?	Su	W	Ferrar&Watson 1970
<i>Nasutitermes longipennis</i>	ca	Au	?	Su	WL	Ferrar&Watson 1970
<i>Nasutitermes torresi</i>	ca,ho	Au	?	Su	?	Ferrar&Watson 1970
<i>Paracornitermes laticephalus</i>	ca	Br	Sa	Ex	S	DeSouza 1993
<i>Procornitermes</i> sp.	?	?	?	?	?	Araujo 1970

<i>Procornitermes</i> sp.	ca	Br	Sa	Ex	S	DeSouza 1993
<i>Rhadinotermes coarctatus</i>	ca	Zi	Bu,Sa	Su	WL	Mitchell 1980
<i>Rhynchotermes nasutissimus</i>	ca	Br	Sa	Ex	L	DeSouza 1993
<i>Rhynchotermes</i> sp. a						
<i>Subulitermes</i> sp.	ca	Br	Sa	Ex	S	DeSouza 1993
<i>Syntermes</i> sp.	ca	Br	Sa	Ex	L	DeSouza 1993
<i>Trinervitermes</i> sp.	ca,el,ho	Na	Bu,Sa	Su	L	Coaton&Sheasby 1972
	ca	Zi	Bu,Sa	Su	L	Mitchell 1980
	ca	BF	AF	Ex	L	Ouédraogo et al. 2004
<i>Tumulitermes comatus</i>	ca	Au	?	Su	WL	Ferrar&Watson 1970
<i>Tumulitermes dalbiensis</i>	ho	Au	?	Su	L	Ferrar&Watson 1970
<i>Velocitermes paucipilis</i>	ca	Br	Sa	Ex	L	DeSouza 1993
<i>Velocitermes</i> spp. 1,2,g	ca	Br	Sa	Ex	L	DeSouza 1993
Termitinae						
<i>Amitermes</i> sp.	br,ca, do,el, go,ho, sh,ze	Na Au	Bu,Sa ?	Su ?	W ?	Coaton&Sheasby 1972 Gay&Calaby 1970
<i>Amitermes abruptus</i>	ca,ho, kw,sh	Au	?	Su	WL	Ferrar&Watson 1970
<i>Amitermes agrilus</i>	ca	Au	?	Su	WL	Ferrar&Watson 1970
<i>Amitermes beaumonti</i>	ca	CR	Pa	Ex	?	Herrick&Lal 1996 Gould et al. 2001
<i>Amitermes boreus</i>	ca,ho	Au	?	Su	WL	Ferrar&Watson 1970
<i>Amitermes capito</i>	ca	Au	?	Su	W	Ferrar&Watson 1970
<i>Amitermes colonus</i>	ho,sh	Au	?	Su	W	Ferrar&Watson 1970
<i>Amitermes darwini</i>	ca,ho, sh	Au	?	Su	WL	Ferrar&Watson 1970
<i>Amitermes dentosus</i>	ca,ho, sh	Au	?	Su	W	Ferrar&Watson 1970
<i>Amitermes deplenus</i>	ho	Au	?	Su	W	Ferrar&Watson 1970
<i>Amitermes eucalypti</i>	ca	Au	?	Su	W	Ferrar&Watson 1970
<i>Amitermes exilis</i>	ca,ho	Au	?	Su	W	Ferrar&Watson 1970
<i>Amitermes germanus</i>	ca,ho	Au	?	Su	W	Ferrar&Watson 1970
<i>Amitermes gracilis</i>	ca	Au	?	Su	?	Ferrar&Watson 1970
<i>Amitermes hartmeyeri</i>	ca,ho, kw	Au	?	Su	W	Ferrar&Watson 1970
<i>Amitermes hastatus</i>	ca,el, ho,to	SA	Bu,Sa	La	L	Skaife 1955
<i>Amitermes herbertensis</i>	ca	Au	?	Su	W	Ferrar&Watson 1970
<i>Amitermes heterognathus</i>	ca	Au	?	Su	WL	Ferrar&Watson 1970
<i>Amitermes lanceolatus</i>	ca,ho	Au	?	Su	W	Ferrar&Watson 1970
<i>Amitermes latidens</i>	ca	Au	?	Su	W	Ferrar&Watson 1970
<i>Amitermes lativentris</i>	ca,ho	Au	?	Su	WL	Ferrar&Watson 1970
<i>Amitermes laurensis</i>	ca	Au	?	Su	L	Ferrar&Watson 1970
<i>Amitermes modicus</i>	ca	Au	?	Su	WL	Ferrar&Watson 1970
<i>Amitermes neogermanus</i>	cam,ca ho	Au	?	Su	WL	Ferrar&Watson 1970
<i>Amitermes obtusidens</i>	ca,ho	Au	?	Su	W	Ferrar&Watson 1970
<i>Amitermes perarmatus</i>	ca,em	Au	?	Su	WL	Ferrar&Watson 1970
<i>Amitermes sciangallorum</i>	el	Ke	Bu,Sa	Su	?	Buxton 1981
<i>Amitermes vitiosus</i>	ca,ho	Au	?	Su	WL	Ferrar&Watson 1970
<i>Amitermes westraliensis</i>	ca	Au	?	Su	WL	Ferrar&Watson 1970
<i>Amitermes wheeleri</i>	ca	USA	De	Ex	W	Ettershank et al. 1980



<i>Amitermes xylophagus</i>	wo	Au	?	Su	W	Whitford et al. 1982
<i>Amitermes</i> spp. I-V	ca	Au	?	Su	L	Ferrar&Watson 1970
<i>Angulitermes</i> sp.	ca,el, ho,sh	Na	Sa	Su	WL	Ferrar&Watson 1970 Coaton&Sheasby 1972
<i>Angulitermes truncatus</i>	di	Tz	Bu	Su	L	Kemp 1955
<i>Anoplotermes</i> sp.	?	?	?	?	?	Weesner 1970
<i>Cubitermes</i> sp.	ca,el, im,ze	Na	Bu,Sa	Su	S	Coaton&Sheasby 1972
<i>Eremotermes</i> sp.	?	?	?	?	?	Roonwal 1970
<i>Gnathamitermes tubiformans</i>	ca	USA	De	Ex	L	Ettershank et al. 1980 Whitford et al. 1982
<i>Lepidotermes</i> sp.	ca,el	Na	Bu,Sa	Su	S	Coaton&Sheasby 1972
<i>Microcerotermes</i> sp.	bu,ca,do, el,ho, hy,ze	Na,Tz,Zi	Bu,Sa	Su	W	Coaton&Sheasby 1972 Kemp 1955 Mitchell 1980
<i>Microcerotermes cavus</i>	ca	Au	?	Su	W	Ferrar&Watson 1970
<i>Microcerotermes distinctus</i>	ca	Au	?	Su	W	Ferrar&Watson 1970
<i>Microcerotermes nervosus</i>	ca	Au	?	Su	W	Ferrar&Watson 1970
<i>Microcerotermes serratus</i>	ca,ho	Au	?	Su	W	Ferrar&Watson 1970
<i>Neocapritermes</i> sp.	?	?	?	?	?	Araujo 1970
<i>Neocapritermes</i> spp. a,b,c	ca	Br	Sa	Ex	S	DeSouza 1993
<i>Neocapritermes araguaia</i>	ca	Br	Sa	Ex	S	DeSouza 1993
<i>Promirotermes</i> sp.	ca,el, ze	Na	Bu,Sa	Su	W	Coaton&Sheasby 1972
<i>Synhamitermes</i> sp.	?	?	?	?	?	Araujo 1970
<i>Termes boultoni</i>	el	Zi	De	Su	W	Mitchell 1980