Soil translocation by termites of the genus *Odontotermes* (Holmgren) (Isoptera: Macrotermitinae) in an arid area of Northern Kenya

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**Summary.** The study was conducted in an arid area of Northern Kenya, Marsabit District. The area receives an average annual rainfall of 200 mm and supports scanty plant and animal life.

The most common termite species are of the genus *Odontotermes*. The assessment of soil sheeting translocated on food surfaces by *O. latericius* (Haviland) and *O. boranicus* Ghidini was carried out using a stratified random design. Both species were found to translocate soil at a rate equivalent to 1059 kg of soil per hectare per year. Rainfall was found to have an influence on the building activity of *Odontotermes* soil sheeting.

*Odontotermes* soil sheeting was shown to differ from other surrounding soils in both physical and chemical properties. Therefore, *Odontotermes* have a significant effect on soil structure and texture.

The ecological importance of plant-feeding termites in arid tropical ecosystems is that they process a great deal of plant material. They accomplish this by removing plant litter from the surface and they recycle nutrients (Wood et al. 1978). However fungus-growing termites are so efficient in their social organization and symbiont-mediated digestive system that little humus is produced (Lee et al. 1971; Wood et al. 1978). Termites also play an important role in the modification of soil structure. Some build mounds of varying sizes (Hesse 1955; Watson 1967; Pomeroy 1976), but most bring up soil as foraging galleries and sheeting which modify the physical and chemical composition of soil, and provide protection while searching for food (Lee et al. 1971).

The construction of covered runways (sheetings) was vividly described by Drummond (1888). They are constructed of soil particles cemented together with salivary secretions, and the construction follows odour trails of pheromones secreted from the sternal gland (Stuart 1969; Kaib et al. 1982). The effect of these termite structures on the modification of the habitat has been summarized by Lee et al. (1971) and Wood et al. (1978). The enormous quantity of soil brought to the surface is later redistributed by rain, wind and sometimes animals, to the surrounding areas or in the case of arid areas may be carried away by rain into seasonal streams or rivers.

Few African studies have been concerned with the measurements of termite soil covering up prospective food material, the main exception being the measurements of Le-page (1974) and Wood et al. (1978) on the termites of the genus *Macrotermes* in West Africa. There are few comparative data on such topics as the amount of soil translocated for covering food material by Macrotermiteinae, and the physical and chemical composition of these structures compared to the surrounding soils. These topics form the subject of this paper which deals primarily with the foraging sheetings of the genus *Odontotermes*. In contrast to galleries which protect the termites moving between the nest and the source of food, sheetings cover the source of food itself.

**Study site**

This research study was conducted in the study area of the UNESCO Integrated Project in Arid Lands (IPAL) in Northern Kenya. The actual site was located near Olturot field station between 2°20' and 2°40'N and 36°40' and 37°20'E (see Fig. 1). The site lies at about 600 m elevation.

The climate, vegetation and topography of the whole IPAL study area was described and mapped by FAO (1971); Edward et al. (1979) and Herlocker (1979). The

![Fig. 1. UNESCO – IPAL study area, and its location in the super-imposed map of Kenya (shaded part)](image-url)
Materials and methods

The species of Odontotermes (O. latericus (Haviland), and O. boranicus Ghidini) studied here construct subterranean nests without epigeal mounds. However, their foraging runways indicate their presence and feeding habits. Their soil sheeting was distinguished from those constructed by other genera e.g., Amitermes, Synacanthotermes and Microtermes at Olturot by its appearance (colour, homogeneity, hardness etc).

To assess the amount of soil translocated as sheeting by Odontotermes, it was assumed that removal of soil sheetings or runways does not inhibit or enhance further soil translocation. This was tested by randomly locating two sets of 15 pairs of 50 × 50 cm quadrat frames over areas containing Odontotermes soil sheeting. The soil sheeting was removed using a small brush from one of each pair of quadrat frames while the soil sheeting in the other frame was lightly marked with a white powder ("Polyfilla") which neither repelled nor attracted the attention of foraging termites. It therefore made it possible to distinguish between old (brightly marked) and new or fresh Odontotermes soil. After a week the fresh Odontotermes soil was collected from each pair. The weights of soil from 15 cleared quadrats and freshly constructed soil from 15 marked quadrats were then compared using the t-test. There was no significant difference found between the amount of fresh Odontotermes soil sheeting on the paired quadrats, t = 0.27, n = 15, P > 0.1, thus confirming the assumption stated above.

In the actual experiment, a permanent transect line 200 m long was laid out and marked at 20 m intervals by fixed posts. Randomly selected strips one metre wide and ten metres long were marked out within each 20 m interval and arranged using a stratified random design (Southwood 1966). This brought the total number of foraging strips established to ten. The experiment layout is shown in Fig. 2. Once established, the foraging strips were used for weekly collections of soil sheetings or runways built by Odontotermes. The experiment was run for 48 weeks and in each week the soil sheeting covering grass and woody material was collected separately. The weekly total quantities of soil sheeting collected from the foraging strips were recorded for the two food categories. The total quantity of soil translocated per hectare per year was then calculated from the soil collected from the two categories within the experimental strips.

The rate of disintegration of foraging soil sheetings to an unrecognisable (and therefore uncollectable) state during the weekly intervals between collections was negligible, especially during the dry seasons and where disturbance by animals was minimal. More frequent collections were made during rainy periods, and were carried out before the start of rain on the following day.

Soil analysis

The soil characteristics of Odontotermes soil sheetings and the adjacent soil profile were examined and compared. The samples from each layer including Odontotermes soil sheeting were analysed by the Kenya Soil Survey, National Agricultural Laboratories, Nairobi. Organic content and base status were determined to assess the effect of Odontotermes activity on the composition of semi-arid soils.

Results

The foraging soil sheeting of Odontotermes is lined with thin brown soil and possesses many pores. The soil sheeting crumbles away within a few weeks after construction and becomes unrecognisable. The Odontotermes workers were observed to utilize smaller fragments of debris from their foraging holes without necessarily covering them with sheeting. In such circumstances very little or no soil was collected. The monthly quantities of soil translocated on grass and on woody material are shown in Table 1. It was evident that the building activity on grass was greater than on woody material because Odontotermes spp. prefer foraging on grass rather than on wood (Bagine 1982) assuming equal availability.

Field observation indicated that the building of the