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An ecological survey of the termites (Isoptera) of Lochinvar National Park, Zambia*

by

P. O Y. NKUNIKA**

Department of Natural History, Livingstone Museum, P.O. Box 60498, Livingstone, Zambia.

As a follow up to investigations already carried out for certain vertebrates, this article presents the first record of the Isoptera of Lochinvar National Park. 23 species have been collected there from three different ecosystems, including periodically flooded plains. Characteristics of habitat, nests and feeding behaviour of the termites and their place in the ecological niche is briefly discussed. Quantitative ecological research on the termite fauna of this National Park remains to be done.

INTRODUCTION

The flora and fauna of Lochinvar National Park in the Southern Province of Zambia have been studied by a number of research workers under the auspices of the Kafue Basin Research Committee. Handlos (1982) summarized the ecological research done up to 1978. This was followed by a provisional checklist of its reptiles and amphibians by Simbotwe and Patterson (1983). Recently Howard (in press) documented a comparative study of the Kafue flats ecosystem in Zambia with that of the flood plain areas of Northern Australia; and Simbotwe and Friend (in press) made a similar comparison of herpetofaunas of the two regions.

One of the prominent features of Lochinvar National Park is the ubiquity of termite fauna which appear to play a significant role in the ecology of this area by, for example, the recycling of nutrients which promotes further plant growth, as well as being a source of food to the large number of birds, reptiles, amphibians and mammals. (M. G. Bingham – personal communication).

Coaton (1957) described Northern Rhodesia (Zambia) as a 'virgin termite territory' because there has been no comprehensive published list on the termites of this area. This paper presents a checklist on the termites of Lochinvar National Park and their distribution, with brief biological and ecological notes. As a species list it fills in a gap between termite faunistic studies carried out in West and East Africa, Zaire and South Africa.

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* Dedicated to the memory of the late Dr. W. G. H. Coaton, a pioneer isopterist who contributed much to our knowledge of the termites of Southern Africa.

** Present address: Waite Agricultural Research Institute, Department of Entomology, Glen Osmond, South Australia, 5064, Australia.

DESCRIPTION OF STUDY AREA

Lochinvar National Park (Fig. 1) lies between 15° 43′–16° 01′S and 27° 10′–27° 19′E. The park covers an area of about 40 500 ha, stretching 32 km from north to south and 13 km from east to west. Vesey-Fitzgerald (1960), Legg (1972) and Douthwaite and Van Lavieren (1977) have described in detail the physiography, geology and soils, vegetation and climate of Lochinvar National Park, while Sheppe and Osborne (1971) described the ecosystems of the Kafue Flats that surround Lochinvar National Park.

There are three main habitats:

(i) The fringing woodland (1000–1010 m above sea level) has outcrops of metamorphic Precambrian rocks, giving rise to well drained loam soils. It is characterized by trees of the genera *Acacia, Albizia* and *Combretum* and is about 8 100 ha in extent.

(ii) The termitaria zone or bush group grassland (990–1000 m above sea level) is located between the woodland and the flood plain and characterized by cracking clays and by sandy patches around larger mounds and drainage lines. Termite mounds built by different species are dominant features. Seasonal waterlogging

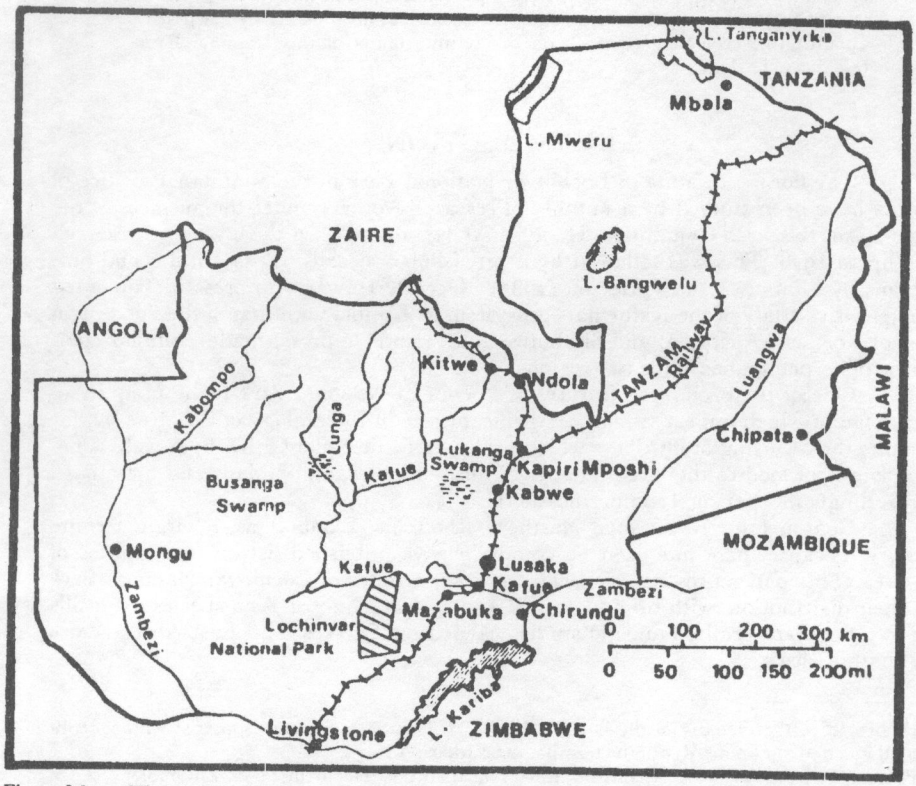


Fig. 1 Map of Zambia, showing location of the study area (Lochinvar National Park).

in this area prevents tree growth in most places except on the termite mounds. This zone covers an area of about 16 200 ha.

(iii) The flood plain (1065–1075 m above sea level) is characterized by annual flooding reaching a maximum depth of 5 m, and montmorillonitic cracking clays when dry. Flood plain grasses and herbs are adaptable to the regular inundation and drying of this zone of about 16 200 ha within Lochinvar National Park.

The general weather patterns in the area are documented in the FAO, 1968 report. The annual rainfall for Lochinvar averages 832,6 mm, the wettest months are December, January and February and rains fall from November to March. The mean annual temperature for Lochinvar is 20,6°C. The range for monthly averages being 16,9°C (June/July) to 23,9°C (October) (Douthwaite and Van Lavieren, 1977). Three seasons in Zambia are recognized: Cool dry (April–August), hot dry (August–November) and warm wet (November–April) (Archer 1971).

MATERIALS and METHODS

This study was done over a period of 7 years. A variety of collecting techniques was used and included extensive collections by either random or systematic sampling of a line transect. Altogether 22 transects were sampled each of 500 m by 30 m. These consisted of 7 transects in the flood plains, 10 in the termitaria and 5 in the woodland. Termite mounds within 10 m from the Chunga road were selected at 1 km intervals using the recording of the Landrover's odometer. The entire mound was dug up. The insects were sorted and mixed and a sample was taken volumetrically. Samples were stored in tubes of 80% methanol until their identification to species, where possible (Nkunika, 1979).

RESULTS

A list of termites identified in this study is presented in Table 1.

Family Hodotermitidae

Hodotermes mossambicus: This is the only primitive species in the family represented. It builds subterranean nests which show external signs of loosely formed low dome-shaped soil dumps. It also has several foraging holes. This species largely feeds on grass, although it can take seeds, dung, and twigs as well (Nkunika, 1979). This termite relies on symbiotic flagellate gut protozoa for the digestion of cellulose. It is present in the three ecological zones, being widely present in the Termitaria.

Family Termitidae

All members of this family lack symbiotic cellulose-digesting intestinal flagellate protozoa, but they have different morphologies, feeding and nesting habits. It is on these bases that it has been split into four different subfamilies. These are Apicotermitinae, Termitinae, Macrotermitinae and Nasutitermitinae.

Sub-Family Apicotermitinae – commonly called *Anoplotermes* spp. Sands (1972) revised this taxonomically difficult group discarding the genus *Anoplotermes* for the soldierless termites of Africa.

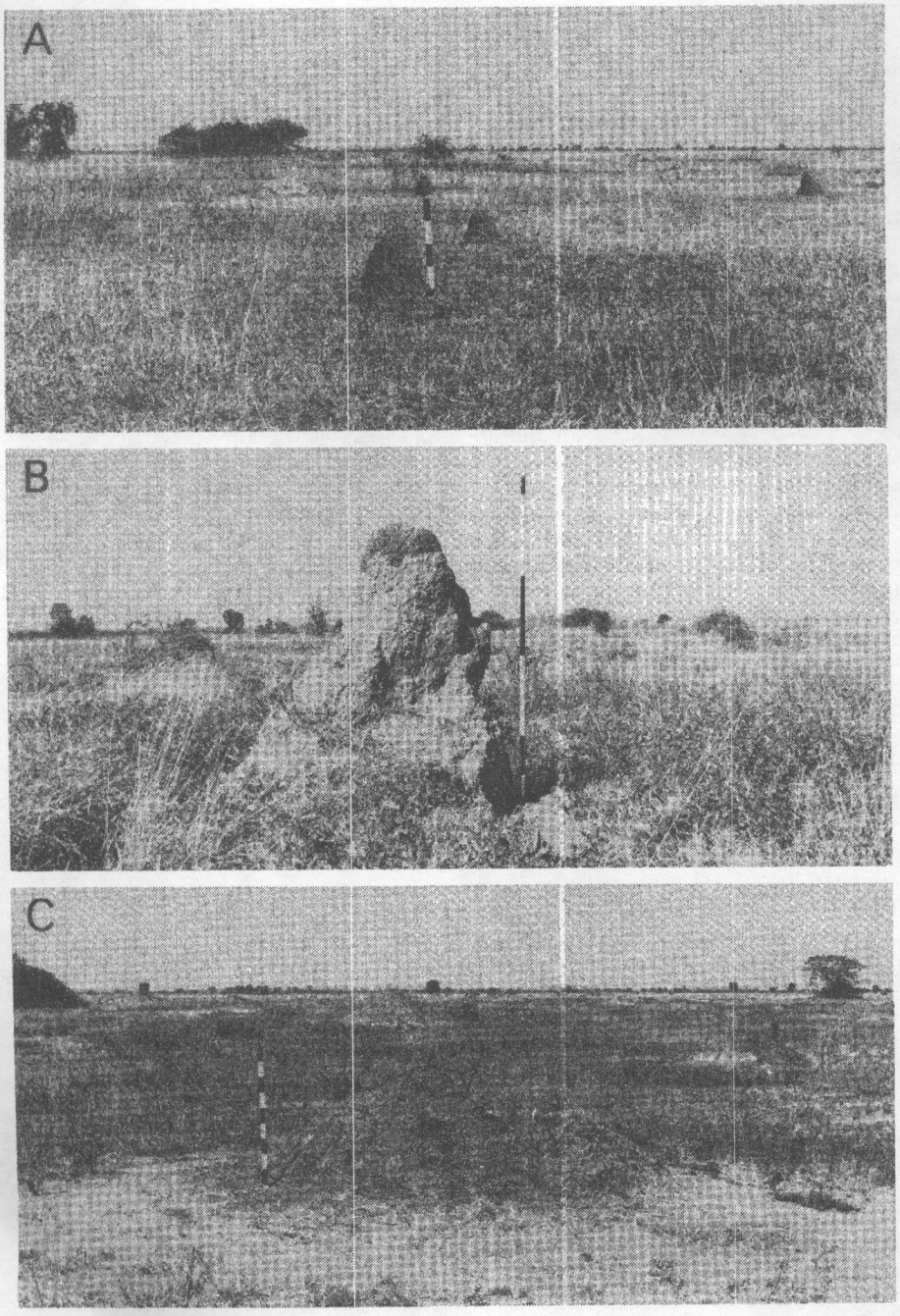
Aganotermes oryctes. This species was found as a 'lodger' in the mounds of *Cubitermes*, in the woodland. They appear to be soil feeders.

TABLE 1. A list of termites in different ecological zones–Lochinvar National Park, Zambia.

Species	Flood plain	Termitaria	Woodland
HODOTERMITIDAE			
Hodotermes mossambicus (Hagen)	+	++	+
TERMITIDAE			
APICOTERMITINAE			
Anenteotermes disluctans Sands	+	–	–
Aganotermes oryctes Sands	–	–	+
TERMITINAE			
Amitermes truncatidens Sands	+	++	+
Crenetermes sp. nr. *mixtus* Williams	–	+	–
Cubitermes tenuiceps (Sjöstedt)	+	++	+
Cubitermes transvaalensis (Fuller)	+	+	+
Cubitermes spp.	–	+	+
Microcerotermes brachygnathus (Silvestri)	+	+	+
Noditermes sp	–	+	+
Promirotermes sp.	–	+	+
MACROTERMITINAE			
Allodontermes tenax (Silvestri)	–	–	+
Allodontermes schultzei (Silvestri)	–	–	+
Ancistrotermes latinotus (Holmgren)	–	+	+
Macrotermes michaelseni (Sjöstedt)	–	+	+
Macrotermes falciger (Gerstaecker)	–	–	+
Macrotermes vitrialates (Sjöstedt)	–	–	+
Macrotermes sp. nr. *albopartitus* (Wood)	–	–	+
Macrotermes vadshaggae (Sjöstedt)	–	–	+
Odontotermes latericius (Haviland)	++	–	–
Odontotermes lacustris (Harris)	–	++	+
Odontotermes sp.	–	–	–
NASUTITERMITINAE			
Trinervitermes bettonianus (Sjöstedt)	+	+	+
Trinervitermes gratiosus (Sjöstedt)	+	–	–
Total number of genera	7	10	12
Total number of species	9	12	19
15 genera	23 species		

– not present at the time of sampling
\+ present at the time of sampling
++ widely present at the time of sampling.

Figs 2. A–C. Termite mounds at Lochinvar National Park.
A. *Cubitermes tenuiceps*
B. *Macrotermes michaelseni*
C. *Odontotermes latericius*


A
B
C

Sub-Family Termitinae

Amitermes truncatidens, found in the outer shell of the mound of *Macrotermes michaelseni*. Workers and soldiers seemed to contain a substantial amount of soil in their gut, implying that these insects may be soil feeders.

Crenetermes sp. near *mixtus*. This species can easily be confused with *Cubitermes* spp. but it differs in that its labrum is less bilobed and its mandibles are short, dark and stout. In the termitaria zone it was collected from the mounds of *Cubitermes* spp., but occasionally it builds dome-shaped mounds which are larger than those of *Cubitermes* (Fig. 2A). They are predominantly soil feeders. *Cubitermes tenuiceps* builds either conical or dome-shaped mounds and is present throughout the study area but widely present in the termitaria zone: predominantly a soil feeder.

Cubitermes transvaalensis. This is the first record of this species for Zambia. It is also a soil feeder and is present in the three study sites where it builds mounds which are either columnar or budded-colonial in form.

Cubitermes spp. generally build mounds which are either columnar or form colonies. They are topsoil feeders and their mounds house other species such as *Ancistrotermes latinotus*. The mounds are solid and decompose very slowly after they have been abandoned and are used as resting sites by birds. Mammals use them to hide from enemies or as an aid in removing ectoparasites. These termites are not present in the flood plain, but they occur in the termitaria and woodland.

Microcerotermes brachygnathus is present throughout the study area. Its nest is composed of hard, tightly packed, concentric layers of yellow-brown organic carton, often 'lodges' in the nests of *Cubitermes tenuiceps* and other *Cubitermes* spp. When the *Cubitermes* termites die, this species takes over the whole nest. *Promirotermes* sp. is a soil feeder, collected in large mounds of *Macrotermes falciger* and occasionally found inside hollow rotten wood and decaying dung. It apparently selects soil of high organic content (Ferrar, 1982) and is present only in the woodland.

Sub-Family Macrotermitinae.

Allodontermes tenax. The nest system is subterranean and diffuse. Swarming of alates takes place at night after the first rains – present only in the woodland.

Allondontermes schultzei. Present in woodland and better adapted to deep sandy soils than *A. rhodesiensis*. Voracious eating makes this species a potential wood destroyer (Coaton and Sheasby, 1972). Biological and distributional notes of these species have been given by Ruelle (1979).

Macrotermes michaelseni. Builds mounds in the woodland and termitaria zones which average 1,5 m in height, and 1,7 m in diameter at ground level (Fig. 2B). It forages extensively in dead decaying wood, dead grass, dung and other vegetable litter.

Macrotermes falciger. Collected only in the woodland, builds large mounds and its 'dead mounds' support a variety of vegetation. Small mammals and large reptiles burrow into these mounds for shelter. It is a voracious feeder and actively forages in logs and stumps.

Macrotermes vitrialatas. Builds small loose mounds between 15 cm and 140 cm high in the woodland zone where it forages during the day, cutting up leaves. The foraging party is made up of small groups. Ruelle (1970) has revised these species.

Macrotermes sp. near *albopartitas*. Collected in the acacia woodland it forages in dead wood and old cow dung and occupies shallow soil galleries and nests of other termites, notably *Cubitermes tenuiceps*.

Odontotermes latericius. Widely present in the flood plain it builds large conical mounds (Fig 2C). Its 'dead mounds' supports varied vegetation (Table 2). They may be used as resting sites by insects and birds during floods.

Odontotermes lacustris. Collected in the woodland and widely present in the termitaria zone as well. Its mounds are similar to those of *O. latericius*, but are not constructed on cracking soils. When the mound is dead, it is subjected to invasion by other termites or black ants, and occasionally grass and other types of vegetation may grow on it. Mounds also serve as resting sites for birds and their droppings are common on top of them.

Odontotermes sp. is a mound builder with a concentrated nest system, present only in the woodland. Its mounds have ventilation shafts which are easily recognized and deserted mounds are occupied by *Microcerotermes brachygnathus*.

Trinervitermes bettonianus. Present in all study sites. In the termitaria, this species has been collected in mounds of *Cubitermes tenuiceps*, but in the woodland it builds its own small mounds wherein short fragments of grass are stored. The nests are characterized by dark brown markings within them. De-alates were collected on 20.xi.80, for the first time. The collection of alates has not been reported before (Williams, 1966).

Trinervitermes gratiosus. Present only in the flood plain, where they have been collected from the mounds of *Cubitermes*.

Vegetation on termite mounds

Termite mounds built by *Odontotermes latericius*, *Cubitermes tenuiceps* and *Macrotermes falciger* frequently support varied vegetation (Table 2). The presence and type of vegetation on these termite mounds reflect both the age of the mound and the effects of its utilization by lechwe. Those adjacent to the high floodline or sandy areas are frequently devoid of vegetation (Douthwaite and van Lavieren 1977). Coaton (1962b) has described and illustrated the vegetation growing on mounds of *Macrotermes* spp. in Zambia. The list in Table II is by no means complete. Future work is therefore desirable in this direction.

TABLE 2. Some plants collected from termite mounds in Lochinvar National Park from December, 1975 to December 1976.

Name of Termite Mound Builder	List of Plants collected
1. *Odontotermes latericius*	*Veronica glabra*
	Acacia albida
	Paederic spp.
	Nidonella spp.
2. *Cubitermes tenuiceps*	*Albizia harveyi*
	Acacia albida
	Combretum ghasalense
	Vitex mombassae
3. *Macrotermes falciger*	*Albizia harveyi*
	Euphorbia ingens
	Acacia nigrescens
	Cappari spp.

DISCUSSION

Generally species diversity (richness) appears to increase from the flood plain to the woodland. At the time of sampling, 9 species were collected from the flood plain, 12 from the termitaria and 19 from the woodland. This may be in part due to availability of suitable nesting sites, and food abundance in the Woodland. This supports Salick and Pong Yow (1984), who found a positive correlation between species richness and suitable niche availability. The numbers of termites presented here may not be exhaustive (Nkunika, 1982). The genera described here are broadly similar to those reported from West and East Africa, Zaire and South Africa, though there are differences in individual species names, due to perhaps differences in habitats.

There are a number of predators of termites which reduce their numbers. The dominant ones are the termitophagous ant species, *Paltothyreus tarsatus* and *Megaponera foetans*. Simbotwe (1983) reported that termites formed a large percentage (86,5%) of the diet of the two lizards in the park (*Lygodactylus chobiensis* FitzSimmons and *L. capensis* (A. Smith)). Other significant predators on termites include the spur-winged goose (*Plectropterus gambensis*) and the aardvark (*Orycteropus afer*), both of which feed on *Macrotermes* spp. (Handlos 1982). Also it is not uncommon for birds, frogs, chameleons and man to feed on alates, which fly in large numbers at particular times of the summer.

The vast numbers of termites of the different species undoubtedly affect not only the topography of the area by building mounds but also move soil nutrients and consume large quantities of plant material.

Quantitative studies of the ecology of termites in Lochinvar National Park are still a big challenge.

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