ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Biodiversity of Termites in Relation to Human Activity: Impact on the Environment in Matam (Senegal)

Tamsire SAMB[1], Abdoulaye B. NDIAYE[2], Karamoko DIARRA[1]

[1] Department of Animal Biology, Faculty of Science and Applied Sciences, Cheikh Anta Diop University of Dakar, Box 5005, Dakar SENEGAL.
[2]Laboratory of zoology of terrestrial invertebrates, Department of animal Biology, IFAN Institute, Box 206, Dakar, SENEGAL

ABSTRACT

An entomological survey was conducted in Senegal, Matam to (1) make an inventory of termites in the various ecosystems: grazing land, farms and houses, and (2)assess the impact of the interaction between termites and human activity in those environments. There was apoorbiodiversity due to the environmental degradation. Over 16 species of termiteswere identified,including*Amitermes aff. hastatus* reported for the first time in Senegal. The species belong to two families (Rhinotermitidae and Termitidae), divided into five subfamilies and 12 genera. Bothtermite diversity and species distribution were affected by human activity which favorspotential pestspecies to human and his environment. In houses, two lignivorous species, (*Amitermes evuncifer*and*Psammotermes hybostoma*)anda fungivorousspecies(*Odontotermes* spp.)are reported to cause minor damages. In sahelian agro-ecosystems, termites are minor pests attacking particularly farm fences inducing deforestation.However, most of termites recorded in this survey are known to have abeneficial activity in recycling of organic matter.

Keywords:Termites, degraded sahelian savanna, Senegal.

Corresponding author
Email: karamoko.diarra@ucad.edu.sn

ISSN: 0975-8585

INTRODUCTION

Termites (insect: Isoptera) are one of the most fascinating group of social insects in the world. The taxonomy andecology of termites in Africahave been remarkably studied, (Krishna & Weesner, 1969, 1970; Lee &wood, 1971; Grassé1949, 1982, 1984, 1986).The high interest for this group is justified by their wide distribution and their various ecological role (pest or beneficial) they play in the environments. Besides their pest status termites play a major ecological role through promotion of essential ecological processes in agro ecosystems. In natural ecosystems, termites can play a beneficial role (Black &Okwakol, 1997; Jouquet*et al*., 2004). The nuisance of termites in wood, books, food, etc., isserious and has been reported (Wood *et al*., 1980; Collins, 1984; Aisagbonhi, 1989). For that reason Grassé (1949) gave the name "wound in hot countries".Chemical sprays are the most common current control strategies.However attempt aiming at using of entomopathogenic fungi have been studied (Rath, 2000).

Because of their ecological and economicalimportance (impact on ecosystems, crop pests, attacks of fruit trees, etc.) studies on termites have been conducted in Senegal mostly in the western area of the country(Roy-Noël, 1974;Roy-Noël &Wane, 1977;Sarr, 1999; Sarr *et al*., 2001).Termites of the eastern part are poorly studied, particularly in the Matam region, the Sahelian zone where biodiversity has been seriously affected. It was therefore necessary to study the activity of the termites in that ecosystem to assess their impact on the environment.

The work aims at:

(1) Making an inventory of species of termites in the grazing lands, agro systems and houses;

(2) Evaluatingtheimpact of human/termites interactions on the environment.

MATERIALS AND METHODS

Study site

The investigation was conducted in Matam region (north eastern Senegal, West Africa). The climate is Sahelian regional intermediary between Sudanese and Saharan climates. Rainfall is unimodal and lasts for 4 months (from July to October). Temporaland spatial irregularity is one of the major characteristicsof rainfall distribution in this area. Annualrainfall is ranging from 250 mm to 550 mm.

The study site belongs to the Senegalese-Mauritanian basin and is characterized by sandy formations and outcrops of ferruginous cuirass. The vegetation of the Sahelian region, which is a transition between the Sahara and Sudan vegetation is characterized by few trees and shrubsmost often stunted.Our studies have been conducted at Danthiady village, located in

the rural community of Ogo in Matam region,around 700 km from Dakar. Danthiady is located in an agro-pastoral area.

Depending on the local designation, there are two ecological zones called *Seno* and *Sangre*characterizedby the type of soil and vegetation.

The *Sangre* is located on the ferruginous cuirass. It is characterized by a sand-clay covered with trees and herbaceous. In some places there are emergencesof ferruginous cuirass without vegetation. The main treesin that area are *Pterocarpus lucens*, *Grewia spp*. and *Dalbergia melanoxylon*.

The *Seno* is characterized by sandy soil, without*Pterocarpus lucens, Dalbergia melanoxylon* and *Grewia spp*. and there isremarkable presence of *Combretum glutinosum, C. micranthum* and *Guiera senegalensis*.

Sampling

Houses, farms (millet) and grazing lands(*Seno* and *Sangre*) have been studied.

In each of these habitats, we first started by studyingthe configuration (plant species, cover, soil type, number of nests of termites, etc.) to get a better approach. Samples are broughtto laboratory for accurate identification.

For the collectionof termites, fourplots (20 × 20 m)were selected in each of the two ecozones *(Sangre and Seno)*. Termites are checked in the galleries, on trees, wooden branches and litter. Nests wereopened to collect termites within.

In the farms, three (3) fields of millet have been studied. In each, an area of one hectare has been defined and the search for termites was done aroundthe cultivated areas and the fences. In the cultivated areas, the termites are checkedinside galleries, on the ground, the stems of millet, trees and shrubs, cow dung.

On the fence made of wooden stakes, 15 picketsare removed at a distance of 20 m. The termites that attack picketsfrom outside andinside are collected.

In houses, sampling was done in eight (8) concessions. Termites are checkedon fences made of wooden pickets from inside and outside of buildings, trees and anything that can host termites.

Termites were kept in ethanol 75 °, precisely labeled. The identification of species was donein the Laboratory of Zoology of Terrestrial Invertebrate (IFAN Institute, Cheikh Anta Diop University)usingcollection of reference and others works on termites in Africa.According to Dajoz (1971)classification there three descriptions: accidental species (less than 25% presence); secondary species (25-50% presence) and constant species (more than 50% presence).

ISSN: 0975-8585

Classification (*)and frequencies of termites collected in Matam

Species		Frequencies(%)
Secondaryspecies	*Psammotermes hybostoma*	30.97
Accidentalspecies	*Microcerotermes spp.*	11.81
	Microtermes lepidus	11.02
	Odontotermes spp.	10.5
	Amitermes evuncifer	7.09
	Macrotermes subhyalinus	6.56
	Trinervitermes geminatus	6.3
	Microtermes grassei	4.99
	Trinervitermes trinervius	3.94
	Microtermes subhyalinus	2.36
	Amitermes aff. hastatus	1.84
	Angulitermes nilensis	0.79
	Cubitermes curtatus	0.79
	Coptotermes intermedius	0.52
	Eremotermes sp.	0.26
	Promirotermes holmgreni	0.26

A total of 19 plotsof four biotopes were studied. Over 317 samples of termites were collected corresponding to a surface area of 33,200 m^{-2}, excluding houses.

RESULTS

Biodiversity of termites

More than 16 species of termites belonging to belong to two families, five subfamilies and 12 genera were collected.

ISSN: 0975-8585

List of termites species in Matam region (Senegal, West African)

Family	Subfamily	Genus	Species
Rhinotermitidae	Coptotermitinae	*Coptotermes*	*Coptotermes intermedius*
	Psammotermitinae	*Psammotermes*	*Psammotermes hybostoma*
Termitidae	Termitinae	*Amitermes*	*Amitermes evuncifer*
			Amitermes near. hastatus
		Angulitermes	*Angulitermes nilensis*
		Cubitermes	*Cubitermes curtatus*
		Eremotermes	*Eremotermes sp.*
		Microcerotermes	*Microcerotermes sp.*
		Promirotermes	*Promirotermes holmgreni*
	Macrotermitinae	*Macrotermes*	*Macrotermes subhyalinus*
		Microtermes	*Microtermes grassei*
			Microtermes lepidus
			Microtermes subhyalinus
		Odontotermes	*Odontotermes sp.*
	Nasutitermitinae	*Trinervitermes*	*Trinervitermes geminatus*
			Trinervitermes trinervius

Species frequency in the selectedhabitats

The accidental species are *Microcerotermes sp. Microtermes lepidus, Odontotermes sp. Amitermes evuncifer, Macrotermes subhyalinus, Trinervitermes geminatus, Microtermes grassei, T. trinervius, Microtermes subhyalinus, Amitermes nearhastatus*,*Angulitermes nilensis, Cubitermes curtatus, Coptotermes intermedius*, *Eremotermes sp*. and *PromirotermesHolmgren*.As secondary species, we have *Psammotermes hybostoma.*

Diversity of termites in the different habitats

There was a decrease in the number of species of termites from the *Sangre* to the concessions (figures 1 to 6). Of the 16 species recorded, 12 are present in the *Sangre,* 11 in the *Seno*, 10 in the farms and only 3in the concessions.

ISSN: 0975-8585

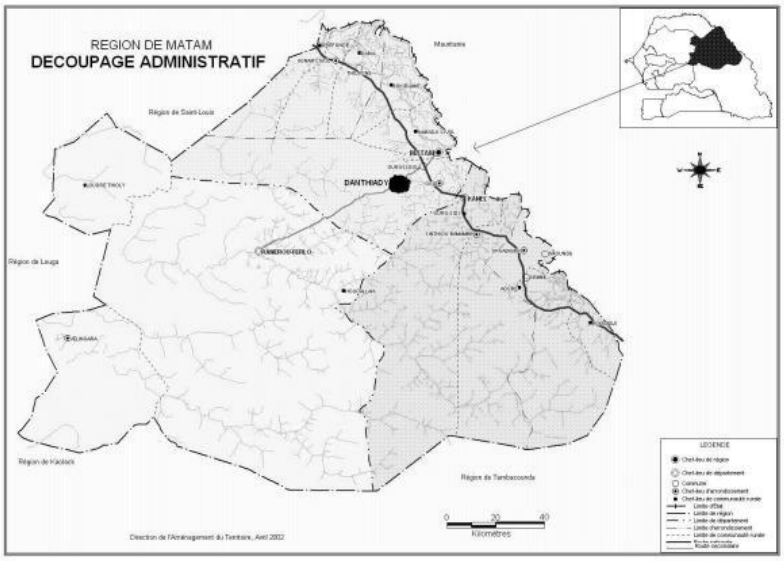


Figure 1:Map of the region of Matam (Senegal, West Africa).

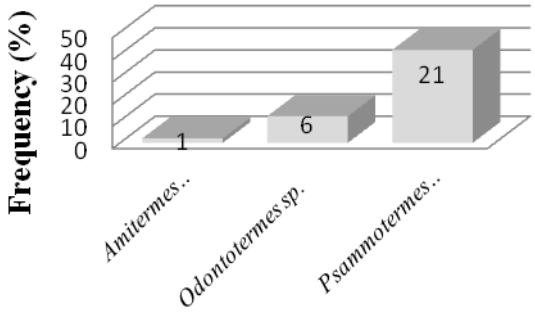
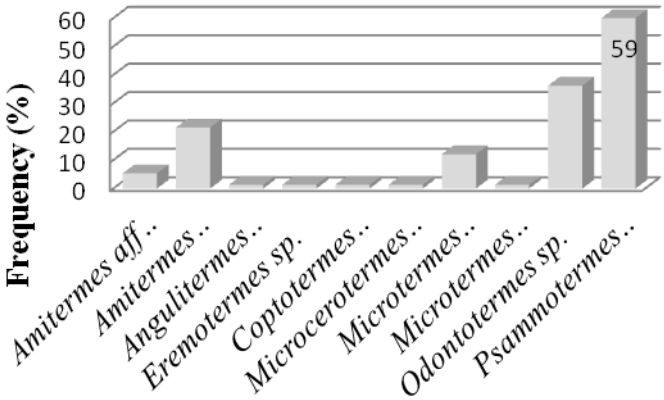


Figure 2: Frequencies of termitespecies in concessions in Matam region (Senegal)



ISSN: 0975-8585

DISCUSSION AND CONCLUSION

The distribution and frequency of termite species in the selected habitats are strongly affectedby human presence. These effects, depending on the type of environment can favor somehow certain species whose impacts can be directly or indirectly harmful to human and his environment.In the concessions two lignivorous species (*Amitermes evuncifer* and *Psammotermes hybostoma*) andfungivorousspecies *Odontotermes spp.* are causing damages. *Amitermes evuncifer* and *Odontotermes* are mostly foundon fence pickets causing a permanent renewal. *Psammotermes hybostoma* occurs both on fences and buildings where it attacks any wooden material (roofs, doors and windows in wood, furniture, clothes, and food stored).The constant renewal of fences with poles cut from trees in*Sangre* and *Seno*accelerates their ecological degradation.

The samplingin the agricultural areas (millet fields) was conducted during the dry season. We were not able monitor the termite nuisance on crops. However, according to Ndiaye (personal communication), the termites are minor pests in those areas. Termites (especially *Odontotermes* and*Psammotermes*) are truly harmful during the seedlings but this can be avoided simply by treating the seed with chemicals.The harmful aspect found in agricultural systems and related to termites is the attack on farm fences. A relatively large number of termitespecies attack pickets fences. These are mainly *Amitermes, Eremotermes, Microcerotermes*, *Coptotermes* and *Psammotermes*, *Odontotermes sp*.,*Microtermes* sp. Theyspoilthe pickets and causean annual renewal of fences therefore, leading tothe destruction of trees from *Seno*and *Sangre*.

Such damages,particularly in agro ecosystems, caused by termites have been observed by several authors. Johnson *at al*. (1981) made a survey of termite damageson groundnuts and an estimation of yield-loss in northern Nigeria and noted that the foliage was attacked by *Odontotermes*. Damages were restricted inthe Sudan savanna and loss in yield was less than 5%. Damages caused by *Microtermes lepidus* Sjostedt were more important since it attacks also pods, the roots and the yield. Wood *et al*. (1980 a) studied the abundance of termites, damages to plants and loss in yield in the southern Guineasavanna zone of Nigeria. They reported that virtually all damage was caused by *Microtermes* which has deepersubterranean nests diffusion and attacks maize. Yield losses varied from 0.1 to 9.5%. Wood *et al*. (1980 b) made a survey of yield losses in yam due to soil pests: a wide variety of pest including termites (*Amitermes*), yam beetles,nematodes and various 'rots' are reported to caused significant losses.

In the fields, *Odontotermes, Microtermes*and *Psammotermes*recyclescrop residues (including canes of millet) and cow dung used for fertilizing. The degraded organic matter would return to the soil like minerals (C, N, P, K .etc.). By their construction activity (nests, galleries, veneer), these termites rework and aerate the soil, increasing its porosity and its ability to absorption and retention of water. Such observation has been reportedby Black and Okwakol (1997) and Jouquet *et al*. (2004). In natural ecosystems, termites are typical ecosystem engineers and dominant species in semi-arid ecosystems. Fungivorus termites (Isoptera,

Macrotermitinae) play an important role in tropical ecosystems: they modify soil physical properties and soavail food for other organisms.

Our sampling was conducted during the dry season, during which some species of termites seek refuge deep in the wood and soil. It allowed usto identify over 16 species distributed in 12 genera. The number of species we have recorded was lower than Roy-Noëlinventories (1969) in National Park Niokolo Koba, Roy-Noël (1974) and Roy-Noël & Wane (1977) in Dakar and Sarr (1999) in Kaolack, wherebyrespectively 39, 30 and 20 species of termites were reported. This difference can be explained primarily by the greater diversity of these environments but also by thehumid climate, particularly in Kaolack and Niokolo Koba. As reportedby Lepage (1983), species repartition depends on rainfall-vegetation gradient.

It is important to mention thatfor the first time in Senegal, *Amitermes near hastatus*is reportedwhich increases its range. In fact, according to Sands(1959) this species wasfoundonly in southern Africa.

Lepage (1974) identified in a Sahelian savanna of northern Senegal, 23 species which are distributed in 12 genera. The same number of genera has been recorded during ourstudy in Matam area. So the genus*Eremotermes* which ispresent only in our inventory while *Tuberculitermes*is only present in the inventory of Lepage. The *Eremotermes* recorded can be assimilated to*E. senegalensis*, described in Senegal and itsbiotope is Richard-Toll area, near the study site of Lepage(1974).

The poordiversity of termites recorded during our study could be explained by the degradation of ecosystemsdue to the disappearance of some species. The study of the frequency of species on the four habitats showed the dominance of *Psammotermes hybostoma* which is constant in the reports of Lepage in those areas (1974).

The distribution of termites in the four selected habitats shows a gradual decrease in species diversity from the environment less frequented by human, the *Sangre*, to the most frequented areas likeconcessions. Wood*et al*., (1977) reported the same effect in a Guinea savanna of Nigeria. These authors observeda variationofthe number of species of termites from the natural woodland (23) to the corn farms (4-8).

The damagesof termites on fences imposesannual renewal, increasing pressure on plant resources of the savanna as mentioned earlierby Nel*et al*., (1996) about the effects of *Psammotermes hybostoma*on the reforestation campaigns in Mauritania.

Our study suggests that, termites constitute a factor of development which must be taken into account,considering the role they play in the ecosystem.

ISSN: 0975-8585

ACKNOWLEDGMENTS

This work was funded by the Department of Biofuels, Renewable Energies and Scientific Research of Senegal. Many thanks are expressed to the population of Danthiady, particularly the family NDIAYE for their useful help.

REFERENCES

Aisagbonhi C. I. (1989) A survey of the destructive effect of *Macrotermes bellicosus* Smeathman (Isoptera: Termitinae - Macrotermitinae) on coconut seednuts at NIFOR, Benin, Nigeria. Tropical pest management, 35(4):380-381.

Black H.I.J., Okwakol. M.J.N. (1997) Agricultural intensification, soil biodiversity and agroecosystem function in the tropics: the role of termites. Applied Soil Ecology 6: 37-53.

Collins N. M. (1984). Termite Damage and Crop Loss Studies in Nigeria -Assessment of Damage to Upland Sugarcane. Tropical Pest Management. 30(1): 26-28.

Dajoz R, (1971) Précis d'écologie. Ed. Dunod, Paris, 434 p.

GrasséP P (1949) Ordre des Isoptères ou Termites. In : Traité de Zoologie, Ed. P.-P. Grassé, IX, Masson, Paris: 408-544.

Grassé PP, (1982) Termitologia. Tome I. Masson, Paris: 700 p.

Grassé PP, (1984) Termitologia. Tome II. Masson, Paris : 627 p.

Grassé PP, (1986) Termitologia. Tome III. Masson, Paris: 7125p.

Johnson, R. A., Lamb, R. W. and Wood, T. G. (1981) Termite Damage and Crop Loss Studies in Nigeria. ASurvey of Damage to Groundnuts. International Journal of Pest Management. 27 (3): 325 — 342

Jouquet P., Boulain N., Gignoux J., Lepage M. (2004) Association between subterranean termites and grasses in a West African savanna: spatial pattern analysis shows a significant role for *Odontotermes n. pauperans*. Applied Soil Ecology 27: 99–107.

Krishna K, Weesner F M (1969) Biology of termites. Vol. 1. New York and London(Acad. Press). 598 p.

Krishna K, Weesner F M (1970) Biology of termites. Vol. 2. New York and London(Acad. Press). 643 p.

Lee K E, Wood T G (1971) Termites and soils. New York (Acad. Press) 251p.

Lepage M, (1974) Les Termites d'une savane sahélienne (Ferlo Septentrional, Sénégal) : peuplement, population, consommation, rôle dans l'écosystème. Thèse d'Etat, Université de Dijon, 344 p.

Lepage M, (1983) Structure et dynamique des peuplements de termites tropicaux. Acta Oecologica / Oecologia Generalis, 4(1): 65-87.

Nel A, Caussanel C, Ly B A, (1996)*Psammotermes hybostoma* Desneux, 1902 in Islamic Republic of Mauritania. Economical and Ecological implications for the destruction of the desert Euphorbias (Isoptera: Rhinotermitidae). Ann. Soc. Entomol. Fr. (N.S), 32 (4): 467-473.

RATH A. C., (2000) The use of entomopathogenic fungi for control of termites. Biocontrol science and technology. 10: 563 – 581.

Roy-Noël J,(1969) Le parc national de Niokolo-Koba (Sénégal). Fascicule III. VIII Isoptera. Mémoire de l'IFAN, 84: 114-167.

Roy-Noël J (1974) Recherches sur l'écologie des Isoptères de la presqu'île du Cap-Vert, Bulletin de l'Institut fondamental d'Afrique noire, Tome XXXVI, série A, n°2- 3 : 291-609.

Roy-Noël J, Wane C (1977) L'attaque des arbres par les Termites dans la presqu'île du Cap-Vert (Sénégal). I. Cas du reboisement sur dunes vives de Malika. Bulletin de l'Institut fondamental d'Afrique noire, Tome 39, série A, n° 1, 124-141.

Sands W A, (1959)A revision of the Termites of the genus *Amitermes* from Ethiopian region (Isoptera, Termitidae, Amitermitinae). Bulletin of the British Museum (Natural History) Entomology, 8 (4): 129-156.

Sarr M (1999) Etude écologique des peuplements de Termites dans les jachères et dans les cultures en zone soudano-sahélienne, au Sénégal, Thèse de doctorat de 3ème cycle de Biologie animale, Université Ch. A. Diop de Dakar, 117 p.

Sarr M., Agbogba C., Russell-Smith A., Masse D. (2001) Effects of soil faunal activity and woody shrubs on water infiltration rates in a semi-arid fallow of Senegal. Applied Soil Ecology. 16: 283–290.

Wood T G, Johnson R A, Ohiagu C E (1977)Populations of Termites (*Isoptera*) in natural and agricultural ecosystem in southern guinea savanna near Mokwa, Nigeria. Geo-Eco-Trop. 1 (2): 139-148.

Wood T. G., Johnson R. A., C. Ohiagu E. (1980) Termite damage and crop loss studies in Nigeria. A review of termite (Isoptera) damage to maize and estimation of damage, loss in yield

and termite (*Microtermes*) abundance at Mokwa. Tropical Pest Management. 26(3): 241 -253.

Wood T. G., Smith R. W., Johnson,R. A., KomolafeP. O.(1980) 'Termite Damage and Crop LossStudies in Nigeria. Pre-harvest Losses to Yams due to Termites and other Soil Pests. International Journal of Pest Management. 26(4): 355 — 370.