African Scientist Vol. 24, No. 4 December 31, 2023
Printed in Nigeria

1595-6881/2023 $80.00 + 0.00

https://africansciientistjournal.org

AFS2023064/24411

Survey of Termites along Yenagoa-Imiringi-Otuoke Axis of Bayelsa State, Southern Nigeria

Richard Uzakah[1,]* and Timothy Epidi[2]

[1]Department of Biological Sciences, University of Africa, Toru-Orua, Sagbama, Bayelsa State, Nigeria
[2]Department of Crop Science, Niger Delta University Amassoma, Bayelsa State, Nigeria.

*Corresponding author Email: richard.uzakah@uat.edu.ng; rikuzakah@gmail.com, Tel: +234 (0) 805 623 5594

(Received December 18, 2023; Accepted in revised form December 30, 2023)

ABSTRACT: Termites are very useful in tropical ecosystems as they contribute greatly to decomposition of organic matter, nutrients recycling, and to soil improvements and fertility. However, they also constitute very significant negative impacts to man and society worldwide, owing to their devastations on crops, forestry and to household and public resources. Knowledge of correct termite species composition, and distributions for a given area or locality, are prerequisites for their effective control; and so formed the key objective of this survey along the Yenagoa-Imiringi-Otuoke axis of Bayelsa State, Nigeria. The study identified 3 main termite genera as predominant here namely, *Microtermes* Wasmann (71%), *Macrotermes* Holmsgren (19%) and *Globitermes* Holmgren (10%). Relatively higher termite incidences were recorded at Imiringi, and Otuasega compared to the scanty numbers observed at the other three locations; and these variations may be due to the intense human interferances and infrastructural developments (i.e. more farming activities, housing and road projects at the latter places than at the former, and their resultant impacts on termite abodes). The Simpson's diversity index for the entire study area was 0.445, suggestive of a generally moderate termite species abundance and distribution. The results recorded here would guide future projects in this area and may also be helpful when contemplating cheap and sustainable control options against termites for Bayelsa State in general.

Keywords: Species composition, Diversity index, *Microtermes, Macrotermes, Globitermes,* Termite mounds

Introduction

Termites belong to the insect Order Blattodea (ITIS, 2018), and are well established key decomposers in food chains particularly in tropical ecosystems (Wood and Sands, 1978; Jones and Eggleton, 2000). Termite activities ultimately result in recycling of waste materials (Freymann *et al*., 2008), facilitation of soil drainage and aeration (Donovan *et al*., 2001), improved soil fertility (Lee and Wood, 1971, Wang *et al*., 2009) amongst others. Nonetheless, they also constitute tremendous and significant negative impacts to humanity globally, due to their destructions to field and stored crops; wood and timber, buildings and household resources (Borror *et al*., 1989, Wang *et al*., 2009, Ogbedeh *et al*., 2019). Consequently, colossal sums and scarce foreign reserves are expended annually by nations and organizations for termite management and controls. Ahmad *et al*. (2021) reports that over USD40 billion are spent yearly for this purpose and that this figure is still on the rise due to the increasing economic losses from them.

Termites exhibit a wide range of dietary, foraging and nesting habits, with some species showing high degree of resource specialization (Wood, 1978; Sleaford, Bignell and Eggleton, 1996, Wang *et al*., 2009). Termites influence on decomposition processes at any site or location for instance, would therefore largely depend on the species composition of the local termite assemblage (Lawton *et al*., 1996). This fact underscores the need to know/determine the exact termite species in each locality. More importantly also, is the fact that proper identification of termite species and knowledge of their distributions in an area or locality are the first steps in developing environmentally compatible and sustainable integrated pest management (IPM) strategies (Wang *et al*., 2009; Ugbomeh *et al*., 2019). There is at present only limited termite survey data for Bayelsa State and for most of the Niger Delta. This present survey on the termites of the Yenagoa-Imiringi-Otuoke axis of Bayelsa State alongside the recent few others (Wekhe *et al*., 2019; Ugbomeh *et al*., 2019; Uzakah & Festus, 2022; Uzakah & Epidi, 2023) are therefore deliberate attempts to help build a termites' baseline data for specific areas, and ultimately for the entire Niger Delta of Nigeria, at large. It hopes to unravel the biodiversity of termites in this southern part of Nigeria; a vital information that may guide future projects and could also be useful when planning environmentally safe and sustainable control programmes.

Materials and methods

Description of survey site: This survey was carried out along the Yenagoa-Imiringi-Otuoke axis of Bayelsa State, specifically at Otuasega, Imiringi, Opu-Emeyal, Kala-Emeyal and Otuoke respectively, which are some Ogbia (Ijaw) communities in Southern Nigeria. The area is situated between latitudes 4º91′93″N and 8º8′36″S, and longitudes 3º23′32″E and 6º39′9″W (Fig. 1), and experiences two rainfall seasons annually, March-July, and then September-October; with brief dry seasons in August, and November to February respectively. The average monthly temperatures here is between 25 and 28 ºC. The vegetation is a typical rainforest swamp; and the soils are generally sandy, muddy and clayey - unstable bases for road and building construction works, especially in the coastal areas (Olorode 2002, Ohwo, 2018). The natives here are predominantly subsistent farmers and fishermen.

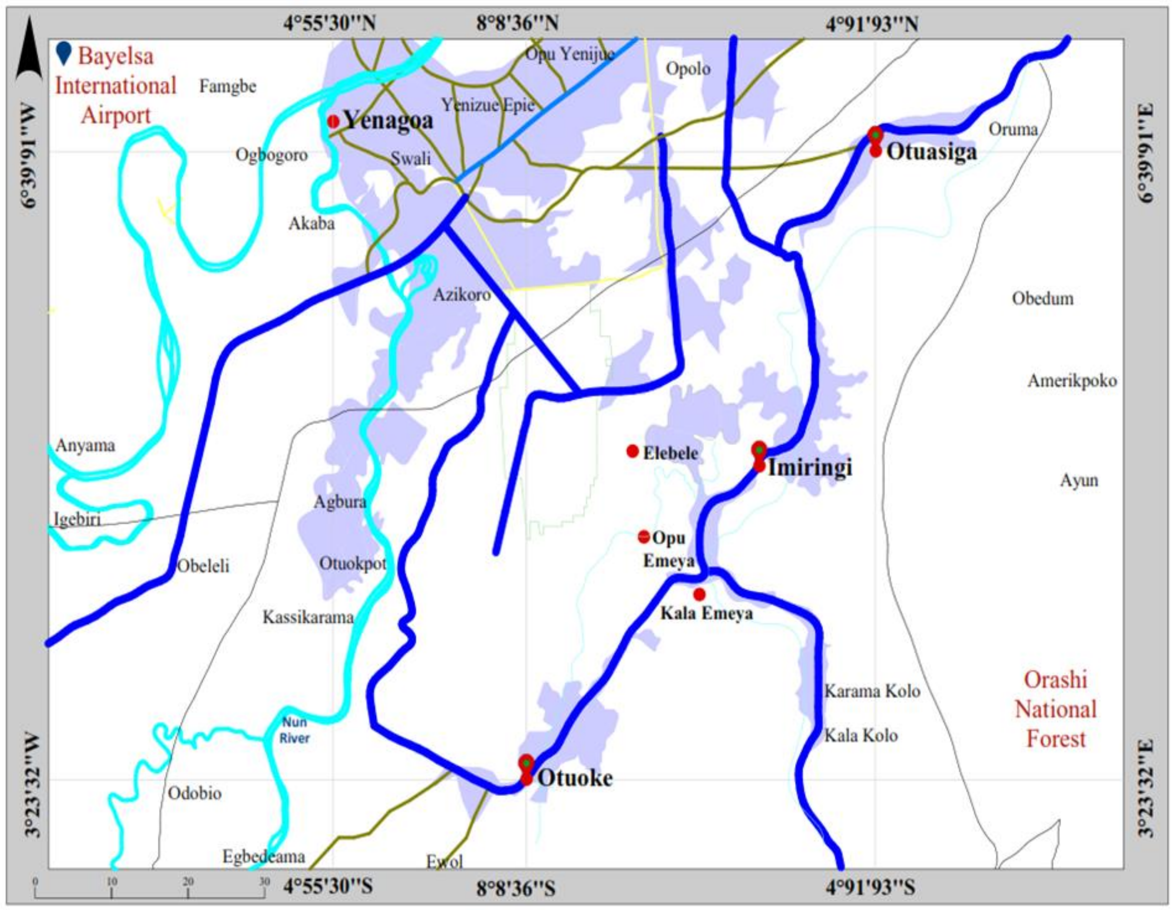


Fig.1: Map showing key locations in Yenagoa-Imiringi-Otuoke axis of Bayelsa State, Southern Nigeria namely – Yenagoa, Otuasega, Imiringi, Opu-Emeyal, Kala-Emeyal and Otuoke respectively

Termites survey strategy: The survey strategy involved monitoring of termites that were found within a 100 m by 20 m transect (Prastyaningsih *et al*., 2020) at each 5-10 minutes' drive along the Yenagoa-Imiringi-Otuoke road. Termite mounds/hills or nests on both sides of the road were always noted and recorded, including the mound heights. A total of 3-5 termite mounds or hills were then randomly selected and slightly cut open with a machete for termite sample collections. Such samples were collected by means of camel's brush or a pair of forceps and carefully placed in perforated Petri-dishes or glass vials and properly labelled with site/location and mound details, as well as collection dates. These were then later transported to the laboratory for species identification. Data collection time at each site/location usually lasted between 20-30min.

Termite species identification: In the laboratory, the collected samples were analyzed by closely examining termite mandibles, pronotum and postmentum areas under the stereomicroscope (model MICS-ST 30LL) and then compared with the identification keys provided by Ahmad (1965) and Scheffrahn & Su (1994) for correct species identifications. Previous researchers (Anantharaju *et al*., 2014, Ugbomeh *et al*., 2019 and Wekhe *et al.*, 2019) adopted similar procedures. Photographic images of all identified termite specimens were always taken also for reference purposes, and for inclusion in the final report. All identifications were made to generic levels only (although the “suspected exact termite species”) are also hereby included, based on the morphological keys and illustrations of Ahmad (1965) (Fig. 2a, b, c).

Results

Termites survey findings: A total of 76 termite mounds were sighted during this survey that involved 5 communities/locations in the Yenagoa-Imiringi-Otuoke axis of Bayelsa State (Table 1). Random inspections on 21 of them, followed by close laboratory examinations revealed that 3 main termite genera are predominant in this axis of Bayelsa State, namely - *Microtermes* Wasmann (71%), *Macrotermes* Holmgren (19%) and *Globitermes* Holmgren (10%) respectively (Table 1, Plate 1a and 1b, Fig. 2 and Fig. 3).

100% of all the termites at Otuasega and Imiringi were *Microtermes* but other termite genera (*Macrotermes* and *Globitermes*) were additionally found at Opu-Emeyal, Kala-Emeyal and Otuoke (as detailed in Table 1, Plates 1a and 1b, and Fig. 3). The diversity index on the termites was 0.445 (Table 2) which indicated a moderate abundance and distribution along this Yenagoa-Imiringi-Otuoke axis of Bayelsa State.

Table 1: Total no. of mounds found, the total examined and the termite species composition per location

Location	Total No. of Mounds found	Total No. of Mounds examined	Species Composition of Termite Mounds		
			Microtermes	*Macrotermes*	*Globitermes*
Otuasega	15	4	4	0	0
Imiringi	40	8	8	0	0
Opu-Emeyal	8	3	1	1	1
Kala-Emeyal	7	3	2	1	0
Otuoke	6	3	0	2	1
Total	**76**	**21**	**15**	**4**	**2**

S/N	Survey Location	Termite Mound	Termite Image	Identified Termite
1.	Otuasega			*Microtermes*
2.	Imiringi			*Microtermes*

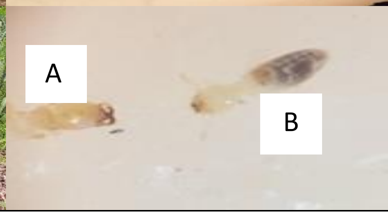
S/N	Survey Location	Termite Mound	Termite Image	*Identified Termite*
3	Opu-Emeyal			*Microtermes*
				*Macrotermes*
				*Globitermes* (A) Soldier (B) Imago

Plate 1a: Plate showing images of identified Termite species and their characteristic mounds at different Locations along Yenagoa-Imiringi-Otuoke Axis, Bayelsa State, Southern Nigeria [1= Otuasega, 2 = Imiringi, 3 = Opu-Emeyal]

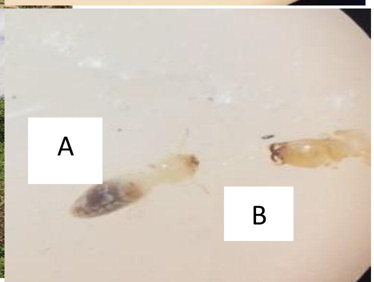
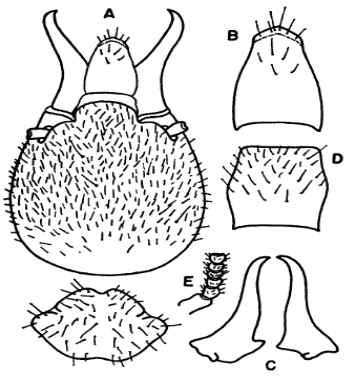
S/N	Survey Location	Termite Mound	Termite Image	*Identified Termite*
4	Kala Emeyal			*Microtermes*
				*Macrotermes*
5	Otuoke			*Globitermes* (A) Imago (B) Soldier
				*Macrotermes*

Plate 1b: Plate showing images of identified Termite species and their characteristic mounds at different Locations along Yenagoa-Imiringi-Otuoke Axis, Bayelsa State, Southern Nigeria [4 = Kala-Emeyal, 5 = Otuoke]

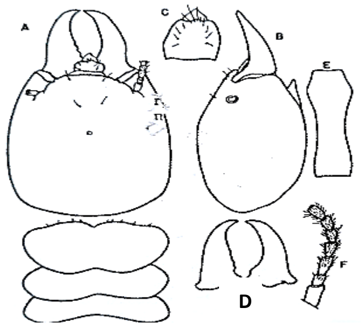


Mandibles with outer margin strongly concave at base… ***Microtermes***

Head oval, mandibles weakly curved apically… ***Microtermes obesi***

Mandibles, slender slightly incurved apically without denticles… ***Microtermes obesi* Holmgren (see c)**

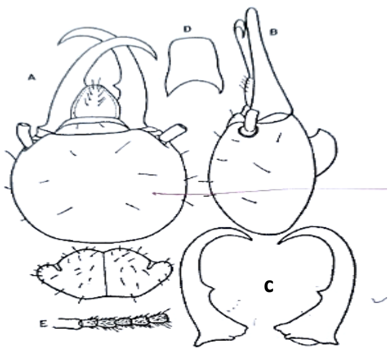
2a: Diagrammatic representation and descriptions on *Microtermes obesi*



Head light reddish brown, slightly darker anterior, Mandible dark reddish brown, lighter at base… ***Macrotermes gilvus***

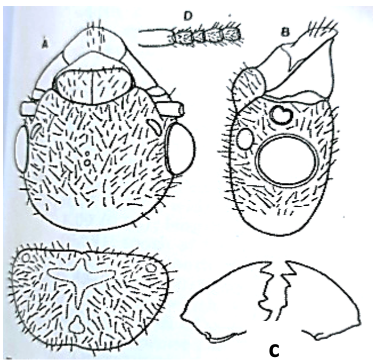
Mandibles stout, thick at bases, tip incurved; left mandible with a few crenulations at base; right mandible without crenulations … ***Macrotermes gilvus*** (see D)

2b: Diagrammatic representation and descriptions on *Macrotermes gilvus*



Head brownish yellow; postclypeus slightly darker than head ***Globitermes sulphureus* (soldier)**

Mandibles reddish in distal half and brownish yellow in posterior half.
Mandibles large, strongly curved, each mandible with a laterally directed tooth situated below middle … ***Globitermes sulphureus* (soldier)** (see C)



Head subcircular, wider than long without mandibles, Eyes are large, bulging, almost circular close to lower margin of head … ***Globitermes sulphureus* (Imago)**

Mandible of ***Globitermes sulphureus* (Imago) (see c)**

2c: Diagrammatic representation and descriptions on *Globitermes sulphureus*

Fig. 2a,b,c: Diagrammatic representations and descriptions of the termites (courtesy: Ahmad,1965)

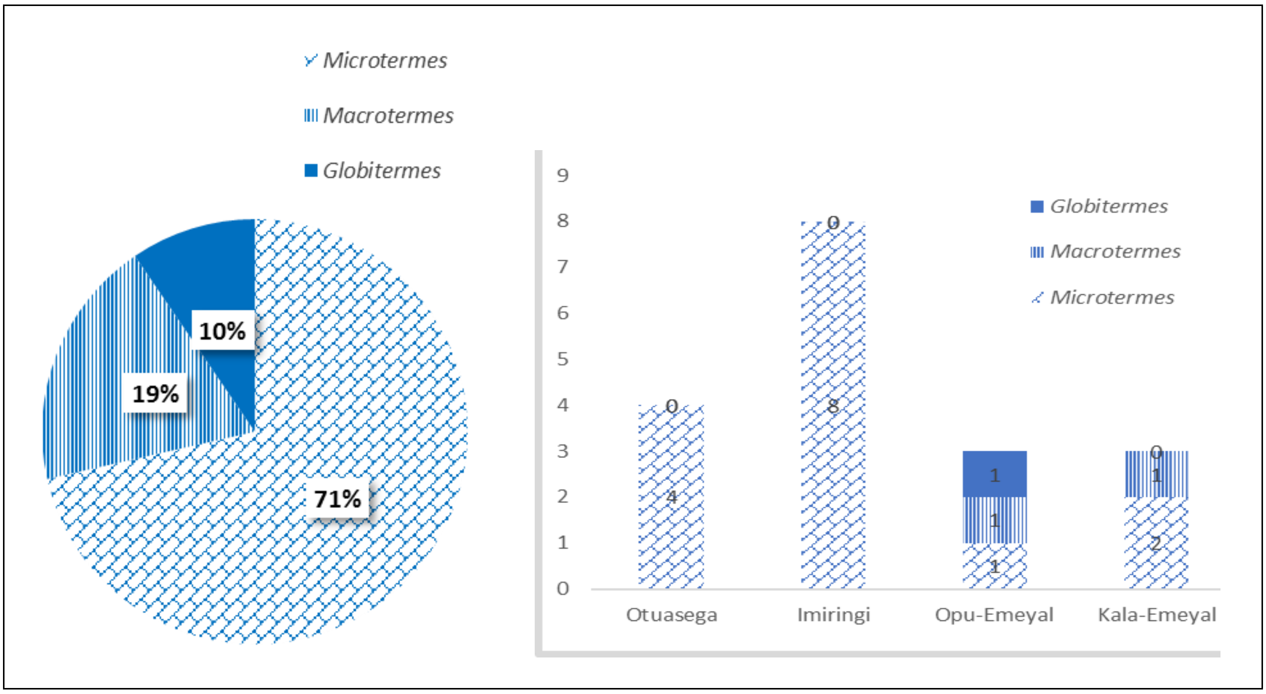


Fig. 3: Species composition of the termites population and their respective spread/distribution per location

Table 2: Relative abundance and species diversity index of Yenagoa-Imiringi-Otuoke termites

Species composition	**N**	**n/N**	**$\sum(n/N)^2$**	**$1 - \sum(n/N)^2$**
Microtermes	15	0.714	0.510	
Macrotermes	4	0.190	0.0361	
Globitermes	2	0.095	0.009	
Total	**21**		**0.551**	**1 – 0.551 = 0.445**

Simpson's index ranges between 0 and 1. Values close to 0 imply low diversity, while values close to 1 indicate high diversity (Jones *et al*., 2014).

Discussion

Termite species are known to vary from locality to locality (Wekhe *et al*. 2019). Three major termite genera *Microtermes, Macrotermes and Globitermes* (in order of abundance) were found along the Yenagoa-Imiringi-Otuoke axis of Bayelsa State; with *Microtermes* being the sole and predominant genus at Otuasega and Imiringi, while the other two (*Macrotermes* and *Globitermes*) were relatively few and featured only at Opu-Emeyal, Kala-Emeyal and Otuoke. The increased farming, bush burning and developmental projects (housing and road) noticed at these communities compared to Otuasega and Imiringi are implicated for the low termites presence observed. Gbarakoro 2022 reported that conversion of natural habitats of arthropods for development and agriculture are common features in Africa and have dire consequences on arthropod species (often causing declines to arthropod diversity).

Similar termite survey work on the Sagbama – Ekeremor axis (Uzakah and Epidi, 2023) had revealed 6 termite genera namely, *Globitermes, Dicuspiditermes, Mirocapritermes, Microtermes, Nasutitermes* and *Hypotermes*. Both works have strongly affirmed the presence of *Microtermes* and *Globitermes* in Bayelsa State; just as Uzakah and Festus' (2022) work also supported this finding of *Macrotermes* in Toru-Orua community of the State, as it featured as the most dominant indoor termite attacking office, laboratory and public structures. *Globitermes* on the other hand was the predominant subterranean termite in Toru-Orua, with characteristic small, symmetrical and dome-shaped mounds (Uzakah and Maika, 2022). Earlier works in neighbouring Port Harcourt, Rivers State had also reported the presence of *Globitermes* (Wekhe *et al*., 2019 and Ugbomeh *et al*., 2019) and *Macrotemes* (Wekhe *et al*., 2019) corroborating the presence of these termites in the Niger Delta of Southern Nigeria.

Work by Kavyashree *et al*. (2022) at Jnanabharathi, Bangalore University (India) found significantly low termite mounds (48; representing 40.38%) at a northern site 1, compared to 71 (or 59.66%) at the south (site 2). They attributed human activity (or meddling) as being principally responsible for this observation, and stressed that biodiversity loss in an area, resulted from high human interference. Environmental factors as fire, rainfall, temperature and soil etc., are other known parameters that could affect termites diversity (Kavyashree *et al*. 2022; Indrayani *et al* 2022). Altitude, according to Indrayani *et al.* (2022) is also a limiting factor to termites species distribution in Indonesia, as increasing altitudes led to a corresponding decrease in termites species diversity. They claimed that cold temperatures at high altitudes, inhibited termites metabolic rates.

The Simpson's diversity index of 0.445 indicated a generally moderate termite abundance and distribution in this region.

Changes to arthropod habitats by destructions, fragmentation and habitat degradations, conversion of forested lands to croplands are known to reduce the species richness and abundance of ecosystems, and constitute threats to African arthropod biodiversity (Gbarakoro, 2022).

The present study has provided a baseline data on the diversity and spatial distribution of termites along the Yenagoa-Imiringi-Otuoke axis of Bayelsa State Nigeria and would help to guide future works; and in planning for environmentally safe and sustainable efforts against termites control in this area.

References

Ahmad M: Termites (Isoptera) of Thailand. Bull Amer Mus Nat Hist,131(1):1-114. 1965.

Ahmad F, Fouad H, Liang S, Hu Y, Mo J: Termites and Chinese agricultural systems: applications and advances in integrated termite management and chemical control. Insect Sci, 28:2-20. 2021 Doi:10. 1111/1744-7914-12726

Anantharaju T, Kaur G, Gajalakshmi S, Abbasi SA. Sampling and identification of termites in Northeastern Puducherry. J Entomol Zool Stud, 2(3): 225-230. 2014

Borror DJ, Triplehorn CA, Johnson NF: An introduction to the Insects. 6th Edition, Saunders College Publishing, Philadelphia, USA. 875p. 1989.

Donovan SE., Eggleton P, Dubbin WE, Batchelder M, Dibog, L: The effect of a soil-feeding termite, *Cubitermes fungifaber* (Isoptera: Termitidae) on soil properties: Termites may be an important source of soil microhabitat heterogeneity in tropical forests. Pedobiologia, 45, 1–11. 2001.

Freymann BP, Buitenwerf R, Desouza O: The importance of termites (Isoptera) for the recycling of herbivore dung in tropical ecosystems: A review. Eur J Entomol.,105: 165–173. 2008.

Gbarakoro NT: Threats to African arthropods biodiversity. Review Article. Environtropica, 17:001-013.2022 ISSN 1597-815X

Indrayani Y, Setyawati D, Mariani Y, Takematsu Y, Yoshimura T: Diversity of termite species at various altitudes in the secondary forest, West Kalimantan, Indonesia. IOP Conf Series: Environ. Earth Sci, 959:1-8. 2022. Doi:10.1088/1755-1315/959/1/0012014

Integrated Taxonomic Information Systems (ITIS): Standard Report. "Blattodea" Taxonomy and Nomenclature. www.itis.gov. Retrieved 10th May, 2018.

Jones DT, Eggleton P: Sampling termite assemblages in tropical forests: Testing a rapid biodiversity assessment protocol. J Appl Ecol,. 37(1):191-203. 2000 Doi:10.1046/1.1365-2664.2000.00464.x

Jones M, Fosbery R, Gregory J, Taylor D: Cambridge International AS and A 'Level Biology Coursework Fourth Edition, Cambridge University Press, United Kingdom. 535p. 2014.

Kavyashree RK, Murugan S, Namratha A. Termite mounds diversity and distribution: a study at Jnanabharathi, Bangalore University. International J Fish Wildl Manag, 6(4): 9-13. 2022. www.aipublications.com/ijfaf

Lawton JH, Bignell DE, Bloemers GF, Eggleton P, Hodda ME: Carbon flux and diversity of nematodes and termites in Cameroon forest soils. Biodivers Conserv, 5:261-273. 1996.

Lee KE, Wood TG: Termites and Soils. Acad. New York. 1971.

Ogbedeh K, Epidi TT, Dialoke SA, Bosah BO, Ugwoke FO: Field survey of cassava susceptibility to termite infestation as influenced by time, scale and management strategy in selected Owerri agricultural zones, Southeast Nigeria. Asian J Adv Agric Res, 10(2):1-10. 2019.

Ohwo O: Climate change impacts, adaptation and vulnerability in the Niger Delta region of Nigeria. Environ Earth Sci, 8:171-179. 2018.

Olorode O: "Vegetation and Fauna" in African Atlases. Atlas of Nigeria. Les Editions. J.A. Paris, France. pp 57-59. 2022.

Prastyaningsih SR, Hardiwinoto S, Musyafa M, Agus C: Diversity of termites (Isoptera) on industrial forest plantation of Eucalyptus pellita stands of tropical ecosystem Riau, Indonesia. Biodiversitas, 21(11):5498-5505. 2020.

Scheffrahn RH, Su N: Keys to Soldier and Winged Termites (Isoptera) of Florida. The Fla. Entomolo.77(4); 460-474. 1994. https://www.jstor.org/stable/3495700

Sleaford F, Bignell DE, Eggleton P: A pilot analysis of gut contents in termites from the Mbalmayo Forest Reserve, Cameroon. Ecol Entomol, 21:279-288. 1996.

Ugbomeh AP, Membere O, Efuka A, Bawo DDS: A rapid survey of the arboreal termites in a university environment in Port Harcourt, Nigeria. J Basic Appl Zool, 80(29). 2019. https://:doi.org/10.1186/s41936-019-0095-1.

Uzakah R, Epidi T: Survey of termites along Sagbama-Ekeremor axis of Bayelsa State, Southern Nigeria. Environtropica, 18:009-020. ISSN 1597-815X. 2023
Uzakah R, Festus A: Survey on indoor termites of Toru-Orua: a university community in Bayelsa Sate, Southern Nigeria. Environtropica, 17:046-054. ISSN 1597-815X. 2022.
Uzakah R, Maika O: Subterranean termites of Toru-Orua: a university community in Bayelsa State, Southern Nigeria. Afr J Trop Entomol Res, 1(3):176-182. 2022. https://doi.org/10.5281/zenodo.7491234
Wang C, Zhou X, Shujuan LL, Schwinghammer M, Scharf ME, Buczkowski G, Bennett G: Survey and identification of Termites (Isoptera: Rhinotermitidae) in Indiana. Ann Entomol Soc Am, 102(6):1029-1036. 2009.
Wekhe C, Ugbomeh AP, Ebere N, Bawo DDS: Subterranean termites of a university environment in Port-Harcourt, Nigeria. Asian J Biol, 8 (2):1-10. 2019.
Wood TG: Food and feeding habits of termites. In: Brian MV, editor. Production Ecology of Ants and Termites. Cambridge University Press, pp. 55-80. 1978.
Wood TG, Sands WA: The role of termites in ecosystems. In: Brian MV, editor. Production Ecology of Ants and Termites. Cambridge University Press, pp. 245-292. 1978.