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TERMITE SPECIES RICHNESS, DIVERSITY UNDER DIFFERENT LAND USE IN RUFIJI DISTRICT

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ABSTRACT: Termite population and foraging behavior is much affected by different land use. Variation in termite species diversity is considered as changes of bio indicators in the selected habitat types. Despite of various benefits obtained from termites little information is known from termite species richness, diversity as well as evenness in response to different land use. A standard transect lines was used to collect termites from 10cm deep to 2M above the ground, hand sorted from the selected different land use. Sampling effort was 1hr per quadrat in all selected land use. Collected specimens were preserved in 70% ethanol for laboratory identification. Termites species encountered during the study period were 16 species from forest, 13 species from cropland and 7 species from grassland habitat types. The coefficient community similarity from different land use was high ranging from 60% to 70% The termites population differences from selected habitat types showed significant differences (P=0.05). This study was carried out to investigate the response of termite population in relation to different land use in Rufiji district which can be used for future research.

Key words: Termite population, termite richness, diversity, land use, disturbance, Rufiji district.

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INTRODUCTION

Termites foraging under different land use results into decline of biodiversity which affect the overall species richness as well as diversity. Regular monitoring with aim to detect changes happening in the ecosystem is very important to assist decision making in response to the changes. Termites can be used as bio-indicator as they are important component in ecosystem management and biodiversity conservation [1].

Furthermore, termite population has a key role in tropical ecosystems function [2]. Termites are one of the main decomposer in tropical terrestrial ecosystems [2]. Termite species richness declined under different land use [3-6]. The area used covers protected forest (Namakutwa), Nyamwage grassland and cropland habitat types. This study aims to investigate termite population in response to alteration of forest habitat into various uses.

METHODOLOGY

Geographical Location

The study on termite species richness, diversity and abundance was carried out, in selected coconut farms, grassland and forest habitats in the district. Rufiji district is located at 178 km to the south of Dar Es Salaam and covers an area of about 53,000 ha (Fig. 1). The prominent feature of the district is the Rufiji River, an eponym for the district. The study area lies between 7° 27′S - 8 ° 27′S and 37° 52′E - 39°28′ E.

Termite Species Sampling Technique

Standardized transect lines 100M long divided into small quadrats (5mx2m) wide were used to generate data for termite species presence or absence in various habitat types and it was assumed that species which were not recorded were either absent or rare.

Species Richness

The data sets from transect lines were assessed firstly by measures of species richness and diversity within each habitat. The number of species within the transect belt in each study site was the species richness (SR). [2,7].

Termite abundance and species richness between the habitat types were tested for differences using one way ANOVA that is to examine significant difference in termite abundance and species richness between habitat types [2].

Species Diversity

The species diversity index in different sites was calculated using the Shannon-Wiener index (H′) [8,9]. This Index takes into account the number of species in the community (species richness) and the number of individuals per species. Similarly the species diversity and richness was also computed using Diversity Programme [10]. The index H′ is calculated as follows: $H' = -\Sigma\, p_i \ln p_i$, where p_i = proportion of total sample belonging to the *ith* species. A greater H′ suggests higher species diversity and smaller H′ suggest low species diversity. Species diversity has two main important components namely species richness and equitability. The Species evenness or equitability was calculated as $J' = H'/ H'_{max}$ [9]. Where by H′= Shannon diversity index and H'_{max} = theoretical maximal value for the Shannon Wiener index of the diversity.

The Coefficient of Community Similarity between Different land use

Similarity indices were used to measure the similarity of species (or families) between habitats. There are two classes of similarity measures. Binary similarity coefficients which are used only when present-absent data are available for species in a community and qualitative similarity coefficients which demand for some measure of relative abundance (number of individuals, biomass cover etc.) for each species. In this study the coefficient of community similarity was calculated using Sørenson coefficient (CCs) [11]. The Community Coefficient Similarity was calculated as follows:- $CCs = \frac{2c}{(s_1 + s_2)}$, where 2C double common species recorded from all communities. s_1 and s_2 are the number of species sampled in communities 1 and 2, respectively and *c* is the number of common species found in both habitats. The value of CCs ranges from 0 (when no common species are found in the community a and community b in all seasons) to 1 (when all species are found common in both season). In other words, these indices are designed equal to 1 (100%) in-case of complete similarity [12,13].

Termite identification

Identification of termite species collected from cropland, forest and grass land was made based on feeding preferences [14-21]. All samples with soldiers were identified to genus level and then allocated with morphospecies number. A working reference collection was maintained so that materials from all transects could be cross-referenced and the morph species designations applied consistently.

RESULTS

Species Richness

The forest habitat had (16) termite species followed by cropland (13) and least was grassland (7). The overall termite species richness was high from the forest than from cropland and the grassland habitats. Figure 1 provides an overview of species richness in different study sites. Common species encountered were as follows *Microcerotermes, Microtermes,Schedorhinotermes,Termes, Pseudacanthotermes*, *Nasutitermes Cubitermes, Macrotermes, Coptotermes, Glyptotermes, Cryptotermes, Ophiotermes, Profastigitermes Fastigitermes* and two genera of *Odontotermes.*

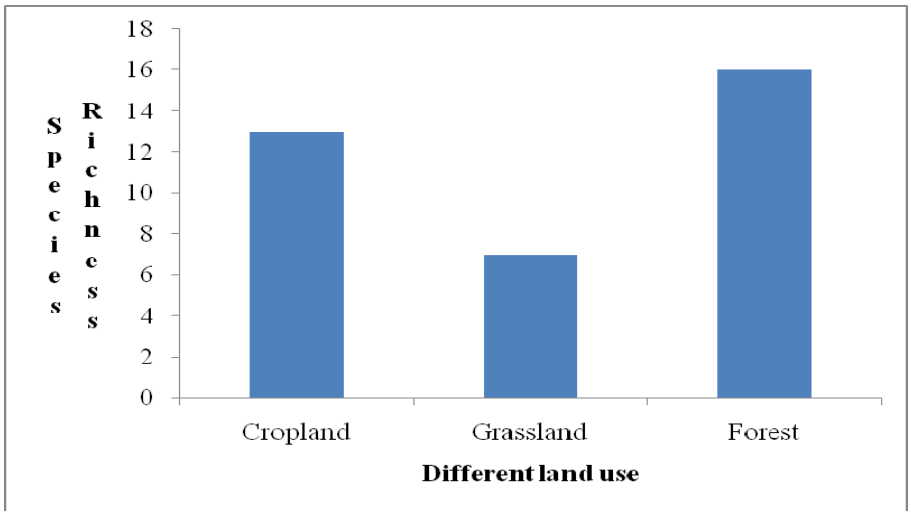


Fig 1: Termites speciess Richness recorded from different land use

Comparison of Termite Abundance between Pairs of Habitat Types

Termite abundance from different habitat types showed there was significant differences p<0.05). On the other hand, comparison between cropland and forest habitat showed significant differences p<0.05).Similarly, the difference between the forest and the grassland showed there was no significant differences (P > 0.05). (Table 1).

Table 1: Tukey-Krammer Multiple Comparison of termite abundance between pairs of habitat types (cropland, grassland and forest) in Rufiji district

Habitat pairs	Mean differences	Q	P	Significance
Crop vs Forest	875.31	3.89	P<0.05	*
Crop vs grass	882.44	3.93	P<0.05	*
Forest vs grassland	7.12	0.03	p>0.05	Ns

Termites species evenness were high in forest habitat **(H′** =1.66), followed by cropland (**H′** =1.56) and the least was grassl **(H′**=0.68) (Table 2).

Table 2: Termites species diversity and evenness from different land use in Rufiji district

	Cropland	Grassland	Forest
Species diveristy ($\mathbf{H'} = -\Sigma\, p_i \ln p_i$,)	1.56	0.68	1.66
Spcies evenness ($\mathbf{J'} = \mathbf{H'}/\mathbf{H'}_{max}$ **)**	0.60	0.35	0.59

The coefficient of similarity of termites community from different land use was observed to be high ranging from 60%-70% (Table 3).

Table 3: Coefficients of Similarity of termite Communities in Rufiji district

	Cropland	Grassland	Forest
Cropland	-		
Grassland	0.70	-	
Forest	0.66	0.60	-

DISCUSSION

Comparison of Termite Abundance between Pairs of Habitat Types

Opening natural forest for various uses in the selected areas has resulted into reduction of number of termite species in the cropland as well as in the grassland. Habitat fragmentation has been shown to negatively influence termite diversity, abundance and biomass in the Amazonian forest [22] and Mabira forest in Uganda [23]. Different land use was characterized by high termite abundance but low species richness was demonstrated to be negatively correlated with the removal of canopy cover in Indonesia [24, 5] suggesting that agricultural intensification tends to reduce physical and biological complexity above the ground thereby increasing termite abundance and lowering termite species richness.

Conversion of forest areas to agriculture results in habitat loss and severe changes in water holding capacities [25, 26, 27]. Termite activity is also influenced by changes in the organic matter and its quality [28]. This is exemplified by the dominance and wide spread occurrence of *Cubitermes* in the forest, grassland areas and partly abandoned fields. Their distribution is probably governed by availability of suitable food and nesting habitats which are altered by the opening up of the forest to agriculture.

Loss of habitat in the grassland was brought about by lighting fires which remove leaf litter and thus destroying suitable conditions for soil inhabiting organisms including soil feeding termites. Indeed the presence of leaf litter in grassland, forest or in cropland areas is important because leaf litter acts as mulch which helps to retain soil moisture making the areas favorable to termites. Similarly, the effect of free range grazing and overgrazing in grassland habitats leads to reduction in the number of species in the selected habitat types. Wood [29] reported that decline of termite species richness in grassland habitats and croplands is due to different human activities eg forest clearing and regular weeding. Termite abundance from different habitats is known to vary from one habitat to another in accordance to species type and human activities. In other studies, Magurran [30] showed that biological diversity differs according to species type. Probably altering the forest habitat to grassland or agriculture influences food availability, nesting sites and reduces natural predators [31].

Termites species Richness, Diversity and Evenness

There were 16 termite species in the primary forest, 13 species in the cropland and 7 species in grassland (Figure 1). Probably the number of termite species sampled was under estimated in contrast to studies carried out in Malaysia [32]. The cropland harboured approximately more than three quarters of the number of termite species found in the primary forest. The lowest species richness was recorded from the grassland possibly because this area is subjected to frequent fires and regular cattle grazing. Human activities including agricultural intensification in Southern Gujarat in India has shown an increase in foraging activity of subterranean termites due to forest landscape degradation [33]. Species evenness in the cropland and forest habitat observed to be high this can explain the availability of good food for different termite species in the cropland after opening of the forest habitat. (Table 2).

The Coefficient of Community Similarity of Termites

The remaining live trees, logs, dead tree stumps in the cropland after forest opening continue to support most of the termite species of the former forest. This implies that the food remaining after forest clearance was adequate both in quality and quantity for different termite species. However, the similarity coefficients between the cropland and the grassland was 70%.Similarly, comparison between cropland and primary forest was 66%. Furthermore, comparison between forest and grassland represent 60% of the species sampled implying that the transition from forest to grassland has a much longer history than the change from forest to agriculture.

The forest and grassland communities were the least similar implying that the type of food available in these communities was very different from each other. The types of food available in two different sites are one of the ecological factors affecting the similarity between the sites. The low value of community similarity between forest and grassland habitats may have partly been due to human activities [34]. Similarity between habitats is useful for establishing ecological species profiles that may guide habitat management decisions, such as priority areas, actions and funding allocation, and to facilitate the long-term conservation of multiple species (Table 3).

CONCLUSION

Termites foraging under different land use were used to assess the effect of disturbance on termite species richness diversity and evenness in the selected habitat types. Changes of natural forest habitat to crop land results into reduction of termite species richness. This can explain the reduction of termites species richness is due to changes of food availability as well as suitable nesting sites. Soil feeding termites were considered as rare species in crop land habitat due to intensive agricultural activities.

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