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RESEARCH ARTICLE

DIVERSITY OF TERMITES IN DIFFERENT FARMING AREAS OF KARNATAKA

***Srinivasa Murtby, K.**

National Bureau of Agricultural Insect Resources, P.B.No. 2491, H.A. Farm Post, Bellary Road, Bangalore -560 024, Karnataka, India

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ABSTRACT

The different agroecological regions of Western Ghats of Karnataka were surveyed to assess the diversity of termites. The distribution revealed occurrence of 12 species of termites in the regions studied. The Macrotermitid *Odontotermes holmgren* occurred predominantly in the Malanad region (17.39- 34.78%). *Odontotermes obesi* was confined to Udupi (27.5%) and Mangalore regions (21.73%). *Nausitermes* sp. was exclusively recorded in the Sirsi region (20.08%). Species richness and abundance was determined by the diversity indices. Higher Shannon's Weiner diversity index (1.72) was registered during 2016-17. The diversity of termites in the regions is discussed in terms of the prevailing cropping pattern and soil type.

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INTRODUCTION

Termites (Isoptera) represent up to 95% of soil insect biomass [1,2] show an elaborated morphology and complex behaviour. Termites are the serious pests of agricultural and horticultural crops that mainly destroy the roots and above ground parts and feed on paper, wood and timber (Murthy, *et al.,* 2015). In India about 300 species within seven families have been reported (Kumar and Pardeshi, 2011). Termites are often referred as "ecosystem engineers" (Jouquet *et al.,* 2006) as they play a vital role in recycling of plant materials and wood, modifying and improving the soil condition and composition, and providing food for other animals (Ackerman *et al.* 2009, Sugimoto *et al.* 2000., Wang Cu., *et al.,* 2009) . Termites are also considered as potent catalysts due to their role involved in converting lignocellulose into biofuels (Deivendran, 2013) and contribute to gas exchange, nitrogen fixation, and soil stability and quality (Bignell 2000).

Termites are abundant throughout the tropics, subtropics and the temperate regions of the world. Tropical regions have the greatest numbers with species diversity, The population density and biomass determines the extent and dimension of their function in an ecosystem (Evans *et al.* 2011).

****Corresponding author:*** **Srinivasa Murtby, K.,**
National Bureau of Agricultural Insect Resources, P.B.No. 2491, H.A. Farm Post, Bellary Road, Bangalore -560 024, Karnataka, India.

The composition in a given region is predisposed by the habitat disturbance and ecological factors (Jones and Eggleton 2000, Pardeshi and Prusty 2010, Luke *et al.,* 2014). Loss in biodiversity and degradation of natural habitats due to climate change and human interference in natural ecosystem has necessitated the need to have an inventory of species richness in an ecosystem. The information on species diversity, richness and relative abundance of termites in different agro ecological regions of Karnataka has not been adequately addressed. It is imperative to understand the species distribution in different regions, so to develop a strategy for their management, and conservation in wild habitats to maintain the ecological balance.

Materials and Methods

Study area: Surveys were carried out in different locations of Karnataka, predominantly in the malanad regions (Western ghats) lying between lying between N 320, 05 to N 310, 12 Latitude and E 760, 32 to E 770, 25 Longitude with Altitude ranging from 1222-2479 m msl. The study area comprised of different cropping patterns . The details of study sites are given in Table 1.

Collection and identification of termite samples: Termite specimens (Soldiers and workers) were collected from the various locations listed in Table 1, by adopting the belt transect method (Eggleton *et al.* 1997, Davies *et al.,* 2003,

Anantharaju *et al.,* 2014). Collections were made at three months intervals from August 2016 to July 2018. The sampling also included the micro habitat (mounds, leaf litter and vegetation) apart from the crop canopy. Contiguous sections of the transect measured 10 sq. m each. The collected specimens were taken to the laboratory at the Division of Molecular Entomology, NBAIR-ICAR Bangalore, The labeled specimens were preserved in 75% (v/v) ethyl alcohol. Taxonomical identification of these specimens was done at the Division of Entomology Indian Agricultural Research Institute, New Delhi, Institute of Wood Science Technology Bangalore, and Centre for Insect taxonomy, University of Agricultural Sciences, Bangalore, by using the keys of Roonwal and Chottani (1989) and , Chottani (1997) and Kalleshwaraswamy *et al.* (2013).

Determination of diversity: The number of species encountered was used as an indicator of relative abundance of species within each habitat. Richness (number of species) and abundance (number of individuals) were assessed. Termite species richness was calculated using Shannon's diversity index (H), Simpson's diversity index (D) and , Evenness (E).. The Shannon index (H') explains the evenness of the abundance of species, while the Simpson index (D) is less sensitive to species richness but more sensitive to the most abundant species (Magurran, 2004).

Shannon diversity index

Simpson's index of diversity

$$D = 1 - \sum_{i=1}^{S} (p_i)^2$$

Simpson's Reciprocal Index = 1/D Pielou's evenness index

$$J' = \frac{H'}{H_{max}}$$

RESULTS

Study area: Species composition: The study area included different regions in Karnataka with varied topography climate, soil and vegetation (Table 1) The surveys were conducted at Bangalore (12.97^0 N., 77.57^0 E), Chintamani (13.40^0 N., 78.05^0 E), Mudigere (13.13^0 N., 75.64^0 E) and Malanad regions (Sringeri , Sirsi , Shimoga and Thirthahalli). The soil type in these areas was of red loamy and red sandy with varied cropping pattern that comprised of rice, small millets, maize, groundnut, sorghum, sugarcane, castor and plantation crops.

Species distribution and abundance: Twelve species of termites were recorded in the areas studied. Bangalore region supported 6 species. Species belonging sub family Macrotermitinae were more predominant in the various areas of study. Seven species of termites were recorded in the Bangalore region. *Microtermes mycophagus* registered 28.38% abundance followed by *Odontotermes longignathus*. (26.08%). *Odontotermes -wallonesis* was recorded in Mysore and Tirthahalli regions. The malanad regions comprising of Mudigere, Sringeri, Shimoga, Sirsi, Belgaum and Chikmagalur recorded occurrence of *Odontotermes holmgren* predominantly. The abundance of the *Odontotermes holmgren* in these regions ranged from 17.39 to 34.78 % . Sirsi recorded the maximum abundance of 34.78%, while, Sringeri registered the lowest of 17.39%. Shivamoga and Belgaum recorded 21.73% abundance each (Table 2). *Odontotermes obesi* was confined to Udupi (27.5%) and Mangalore regions (21.73%). *Nausitermes* sp. was exclusively recorded in the Sirsi region (20.08%)

Diversity indices: The diversity indices was worked out for Malanad region. Shannon Wiener diversity Index (1.72 and 1.68) and lower Simpson index (0.65 and 0.61) was observed (Table 3). The indices have indicated the evenness and abundance of species in the area. The evenness value reveals that the species are distributed evenly in the habitat (0.60 and 0.56 during the years of study). Species diversity and richness varied across the different region. Shannon's diversity index (H) clearly showed that the malanad region was more diverse than others It is known that Simpson's diversity index is more weighted on dominant species compared to Shannon's diversity index.

DISCUSSION

The diversity of termitsin selected regions of Karnataka with emphasis on the malanad region (western ghats) was assessed. The taxonomic composition of termites and their abundance revealed occurrence of species diversity wityh respect to the artea and the cropping pattern. *Odontotermes holmgren* (Macrotermitinae) occurred predominantly in the malanad region comprising the areas of Belgaum, Chintamani, Mudigere, Shivamoga, Sirsi, Sringeri and Thirthahalli, with the abundanc ertanging from 17.39 - 34.78%. The other areas , Udupi and Mangalore distinctly recorded *Odontotermes obesei* as the abundant species (27.5 and 28.9 %, respectively). Bangalore region, however recorded seven varied species, owing to the diversified cropping pattern and soil type. Our observations in the present study are corroborative with the earlier reports of diversity of termite species in the western ghats of karnataka by Varma and Swaran (2007), Vidyashree *et al.,* (2018 and 2018a) and Shanbhag and Sundaraj (2013). Species diversity and richness varied across the regions. the Shanomn diversity index and Simpson index have indicated the evenness and abundance in the area. Our observations are closely in confirmation with findings of Shanbhag and Sundararaj [2013] who reported higher Simpson index in forest compared to plantation. The surveyed landscapes are located in sub-tropical and low humid temperate region (N 300, 12.57 - 12.97 N and 75.72 - 778.05 E) with a broad altitude range (2322 - 2479 msl) which facilitated the diversity of termites in different habitats. The significance of changes in altitude and low temperatures on the abundance and diversity of species richness must be correlated, probably, the low temperatures at high altitudes might limits the development of termites. The natural vegetation and the cropping pattern might have contributed to greater diversity of termite fauna in the region. Most termite assemblages having a more diverse range of food resources with the varying cropping pattern (e.g., wood, soil, and leaf litter) and soil type for nesting strategies (mound, arboreal nests, and nests of wood) as reported by Dawes (2010). Soil parameters, vegetation and microclimate strongly modify the termite communities as opined by Basu *et al.,* (1996). . Land use patterns had an observable impact on the termite species composition and abundance Previous studies by Blanchart and Julka (1997) and Ferry (1992) suggested that increased anthropogenic activity in the region adversely affected the soil macrofauna and diversity, while Menon and Bawa (1997) opined conversion of forest land in to cultivation land with coffee and areca plantations.

Table 1. Characteristics of the study area

Site	District	Geographical Co-ordinates	Cropping pattern	Soil type
Bangalore	Bangalore	12.97^0 N., 77.57^0 E	Rice, Small millets, Maize, Groundnut, sorghum, Sugarcane, castor and vegetables	Red laterite and red loamy
Chintamani	Chikballapur	13.40^0 N., 78.05^0 E	Rice, Small millets, Maize, Groundnut, sorghum, pulses, sunflower, fruit crops and vegetables	Red loamy, Red sandy
Mudigere	Chickmagalur	13.13^0 N., 75.64^0 E	Ragi, Jowar, Maize, pulses, horticultural crops, cardamom, cashew, spices	Red loamy
Malanad region (Chikmagalur Sringeri Sirsi Shimoga Thirthahalli)	Chikmagalur Uttarakanada Shimoga Shimoga	12.57 -13.52^0N., 75.72 -75.22^0 E	Millets, maize, pulses. Arecanut, cocoa, sugarcane, coffee, cardamom and spices	Red loamy

Table 2. Taxonomic composition and relative abundance of different species of Termites in different regions in Karnataka

Location	Termitidae	Sub family	Abundance
Bangalore	*Microtermes mycophagus*	Macrotermitinae	28.38
	Euhamitermes hamatus	Apicotermitinae	11.59
	Hypotermes xenotermitis	Macrotermitinae	8.69
	Hypotermes makhamensis	Macrotermitinae	10.23
	Hypotermes xenotermitis	Macrotermitinae	17.29
	Odontotermes gurdaspurensis	Macr otermitinae	18.84
	Odontotermes longignathus	Macrotermitinae	26.08
Mysore	*Hypotermes xenotermitis*	Macrotermitinae	10.08
	Odontotermes -wallonesis	Macrotermitinae	24.08
Mangalore	*Odontotermes longignathus*	Macrotermitinae	28.9
	Odontotermes obesi	Macrotermitinae	21.73
Mudigere	*Dicuspiditermes Krishna*	Macrotermitinae	23.18
	Odontotermes holmgren	Macrotermitinae	31.8
Sringeri	*Odontotermes holmgren*	Macrotermitinae	17.39
Shivamoga	*Odontotermes holmgren*	Macrotermitinae	21.73
Thirthahalli	*Odontotermes holmgren*	Macrotermitinae	23.01
	Odontotermes -wallonesis	Macrotermitinae	26.08
Belgaum	*Odontotermes holmgren*	Macrotermitinae	21.73
Sirsi	*Odontotermes holmgren*	Macrotermitinae	34.78
	Nasuitermes sp.	Nasutitermitinae	20.38
Chikkamagalur	*Odontotermes holmgren*	Macrotermitinae	17.39
Udupi	*Odontotermes obesei*	Macrotermitinae	27.5

Table 3. Diversity indices values of termites in the Malanad region

Years	Study area	Shannon's Index	Simpson index	Eveness
2016-2017	Malanad region	1.72	0.65	0.60
2017-2018	Malanad regions	1.68	0.61	0.56

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