

Research Article

Subterranean termites diversity in Mianwali District of Punjab, Pakistan

Kausar Fatima¹, Saima Mustafa¹, Bilqees Bano¹, Farkhanda Manzoor², Sana Zahoor³, Masroor Ellahi Babar³ and Tanveer Hussain^{3*}

1. Department of Biology, Virtual University of Pakistan, Lahore-Pakistan

2. Department of Zoology, Lahore College for Women University, Lahore-Pakistan

3. Department of Molecular Biology, Virtual University of Pakistan, Lahore-Pakistan

*Corresponding author's email: tanveer.hussain@vu.edu.pk

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Abstract

Subterranean termites cause destruction to the wooden structures and eat cellulose based products all over the world, causing economic loss on large scale. This study is conducted to observe the presence of subterranean termites and their species in district Mianwali Punjab Pakistan, from the months March to August, 2017. Manual method was used to collect the termites from herbs, weeds, shrubs, trees, plant debris, wooden logs and buildings of desert different areas of the District Mianwali. The population density of termites was estimated using Simpson's diversity index equation. For further examination, the preserved (in 80 percent alcohol) termites were carried to Zoology Department, Lahore College for Women University, Lahore, Pakistan. The number of termites was maximum in the months of July and August. Five species of termites *Coptotermes heimi* (Wasmann), *Microtermes mycophagus*, *Microtermes obesi* (Holmgren), *Odontotermes guptai* and *Odontotermes obesi* (Ramber), were found in three tehsils of the District Mianwali. The most numerous termite species was *C. heimi*. The diversity and population density of termites in Tehsil Mianwali is more than Tehsil EsaKhel and Tehsil Piplan. The aim of the present study is to evaluate population diversity of termites in District Mianwali.

Keywords: Castes; Cellulose based; Diversity; Simpson's diversity index; Subterranean; Workers

Introduction

Termites are social insects which live in colonies and consist of different castes. There are divisions of labour among workers, soldiers and reproductive (queen and king). The termite colonies occur in humus, wood debris, timber and other cellulose containing products [1]. They attack on wooden structures, wooden buildings, wooden furniture and paper products [2]. Local environmental factors, vegetation type, temperature, rainfall, and altitudes affect their number or assemblage in any area [3]. In Pakistan, various studies have been conducted to observe the swarming pattern of termites and have

correlated it with rainfall and temperature [4]. Fifty species of termites have been recorded from different ecological zones of Pakistan [5]. Keeping in view their diversity and role as pest in different ecological zones of Pakistan, this study is conducted to observe the population density of termites in Mianwali District of Pakistan. The district Mianwali is situated in the south-western part of the Punjab province [6]. Average maximum temperature per annum is 47°C and minimum temperature is 19°C. Mean annual rain fall of the Mianwali is 3.3mm and maximum rain fall occurs in the month of July i.e., 6.6cm [7]. This study is conducted in keeping in view

all the environmental factors which affect the distribution and diversity of termites in District Mianwali.

Materials and methods

Total number of 575 Termites was collected from all three Tehsils of the district Mianwali (Piplan, EsaKhel and Mianwali). The samples were collected manually, by using camel hair brush and wooden sticks. Wooden sticks to collect samples were used in another study by Henderson *et al.* in 2016 [8]. The pest activity was observed in deserts, riverine areas, pains and hilly area of the District Mianwali. The samples collected were preserved in 80 % alcohol in air tight glass bottles for laboratory studies. These termites were taken to the Department of Zoology, Lahore College for Women University, Pakistan for further lab examination. Their population density was simply estimated by dividing the total number of termites collected, with the area. In the laboratory, termites were further examined to study the different species under microscope. The termites were collected from the months March to August, 2017. Their percentage abundances were calculated in these months. Five different species of termites were examined and their diversity indices in the three Tehsils of District Mianwali were calculated by Simpson's index. Diversity index of number of individuals of five species of termites was also calculated by Simpson's index.

Results

The external environmental factors including temperature, humidity, texture of soil and wind speed affect the distribution and population density of termites. Population densities of three tehsils varied in accordance with the environmental condition of the areas (Table 1, 2 &3). It was observed that Termites were mostly found in the Tehsil Mianwali with 78.29 % by Simpson's diversity index (Table 4). Five termite species were identified from the samples collected from the different areas of the three Tehsils in different months. On Simpson's index high diversity value was observed in August (1-D= 0.7592) followed by July (1-D= 0.7511). The termite species *Coptotermesheimi* was most abundant in April, June, July and August than other species (Table 5). In July, the number of termites of *Microtermes obesus* increased and in August, it became the most conspicuous species.. In July and August, the increased pest activity was observed (Fig. 1). Diversity index of number of individuals of five species of termites shows that *Coptotermes heimi* was the most abundant species found in District Mianwali. Simpson's equation of index shows a value of $D=0.2266$ of collected sample of termites in district Mianwali. *Coptotermes heimi*, with a value of $P_i=0.0954$, was more abundant than other species and the least abundant species was *Odontotermes guptai* with a value of $P_i=0.0084$ and overall the Simpson's Scale diversity of termites was 77 % (Table 6).

Table 1. Population density of termites in Tehsil Piplan, Distric Mianwali

Date	Location	Area (sq ft)	Places/ materials where termites found	Total No. of termites	Population Density
19-3-2017 29-04-2017 05-05-2017	Chak No. 3-4 ML (Main Line)	40	Playground=33 Houses=23 Cotton field=13	69	1.72
03-06-2017	Alu wali	40	Dead stem of Kikar=6	06	0.15
13-07-2017	Musi Wali	40	Timber =28	28	0.7
19-08-2017	Sargodha U campus	40	Dead <i>Cyprus</i> (Saroo) tree=13 Popular dead stem= 6	19	0.47
Total				122	3.04

Table 2. Population density of termites in Tehsil Esa Khel, District Mianwali

Date	Location	Area (sq. ft)	Places /materials Where termites found	Total No. of Termites	Population Density
16-05-2017	Kamar Mushani	40	Timber =42	42	1.05
14-03-2017 09-06-2017	Tri Khel	40	Living weed=35 Harmal plant=21	56	1.33
09-07-2017	Jinah barrage Kalabagh	40	Living wood of sheesham=10 Wooden log= 26	36	0.9
19-08-2017	Bori khel	40	Wild herb=26 Kari dead stem=22 Cow dung= 09 Wild bush(jall)= 24	81	2.02
Total				215	4.4

Table 3. Population density of termites in Tehsil Mianwali, District Mianwali

Date	Location	Area (sq ft)	Places /material where termites found	Total No. of Termites	Population density
23-03-2017 to 03-04-2017	Aba Khel	40	Dead Kikar stem=23 Brick kiln soil=05 Wild weed=18 Dead tem of Ak and Jand= 33	79	1.97
03-05-2017 to 11-06-2017	Chidru	40	Graveyard grass=10 Dead Kikar stemr=16 Living stem of Kikar=06	32	0.8
10-07-2017	Khabari	40	Dead Kikar stem=10 Peanut shell=05 Narki=13 Sharin dead stem=40	68	1.7
18-08-2017	Musa Khel	40	Wild herb(veran, mahori, boohi) =11 Wild bush(jall)= 17 Dry grasses= 23 Dead stem of Kikar=08	59	1.47
Total				238	5.94

Table 4. Diversity index of number of individuals of five species of termites collected from the three Tehsils of District Mianwali

Species	Tehsil Piplan			Tehsil Isa Khel			Tehsil Mianwali		
	N	n-1	n(n-1)	N	n-1	n (n-1)	N	n-1	n(n-1)
<i>Coptotermes heimi</i>	49	48	2352	62	61	3782	67	66	4422
<i>Microtermes obesus</i>	32	31	992	54	53	2862	59	58	3422
<i>Odontotermes obesus</i>	18	17	306	41	40	1640	48	47	2256
<i>Microtermes mycophagus</i>	14	13	182	37	36	1332	41	40	1640
<i>Odontotermes guptai</i>	09	08	72	21	20	420	23	22	506
N (total no. of species)	122	—	—	215	—	—	238	—	—
	$\Sigma = 3904$			$\Sigma = 10036$			$\Sigma = 12246$		
Simpson's index	D=0.2645 1-D=0.7355			0.2181 1-D=0.7819			0.2171 1-D=0.7829		

Table 5. Monthly variation in diversity indices for termites

Months and name of species	No. Of termites	Percentage	Pi	D= $\sum Pi^2$
March				
<i>Coptotermes heimi</i>	20	26.66	0.2666	0.0710
<i>Microtermes obesus</i>	24	32	0.32	0.1024
<i>Odontotermes obesus</i>	11	14.6	0.1466	0.0214
<i>Odontotermes guptai</i>	20	26.66	0.2666	0.0710
	75			D=0.2658, 1-D= 0.7342
April				
<i>Coptotermes heimi</i>	21	40.38	0.4038	0.1630
<i>Microtermes obesus</i>	12	23.07	0.2307	0.0532
<i>Odontotermes obesus</i>	7	13.46	0.1346	0.0181
<i>Microtermes mycophagus</i>	6	11.53	0.1153	0.0132
<i>Odontotermes guptai</i>	6	11.53	0.1153	0.0132
	52			D= 0.2607, 1-D= 0.7393
May				
<i>Coptotermes heimi</i>	12	25.53	0.2553	0.0651
<i>Microtermes obesus</i>	14	29.78	0.2978	0.0886
<i>Odontotermes guptai</i>	21	44.68	0.4468	0.1996
	47			D=0.3533, 1-D= 0.6467
June				
<i>Coptotermes heimi</i>	21	61.76	0.6176	0.3814
<i>Microtermes obesus</i>	6	17.64	0.1764	0.0311
<i>Odontotermes obesus</i>	5	14.70	0.1470	0.0216
<i>Microtermes mycophagus</i>	2	5.88	0.0588	0.0034
	34			D=0.4375, 1-D= 0.5625
July				
<i>Coptotermes heimi</i>	48	27.42	0.2742	0.0751
<i>Microtermes obesus</i>	45	25.71	0.2571	0.0661
<i>Odontotermes obesus</i>	43	24.57	0.2457	0.0603
<i>Microtermes mycophagus</i>	38	21.71	0.2171	0.0471
<i>Odontotermes guptai</i>	1	0.571	0.0057	0.0003
	175			D=0.2489, 1-D= 0.7511
August				
<i>Coptotermes heimi</i>	56	29.16	0.2916	0.0850
<i>Microtermes obesus</i>	44	22.91	0.2291	0.0524
<i>Odontotermes obesus</i>	41	21.35	0.2135	0.0455
<i>Microtermes mycophagus</i>	46	23.95	0.2395	0.0573
<i>Odontotermes guptai</i>	5	2.604	0.0260	0.0006
	192			D= 0.2408, 1-D= 0.7592

Table 6. Diversity index of number of individuals of five species of termites collected

Name of species	No. of termites	Pi	Pi ²
<i>Coptotermes heimi</i>	178	0.309	0.0954
<i>Microtermes obesus</i>	145	0.252	0.0635
<i>Odontotermes obesus</i>	107	0.1860	0.0343
<i>Microtermes mycophagus</i>	92	0.16	0.0254
<i>Odontotermes guptai</i>	53	0.0921	0.0084
	575		D=0.2266, 1-D=0.7734

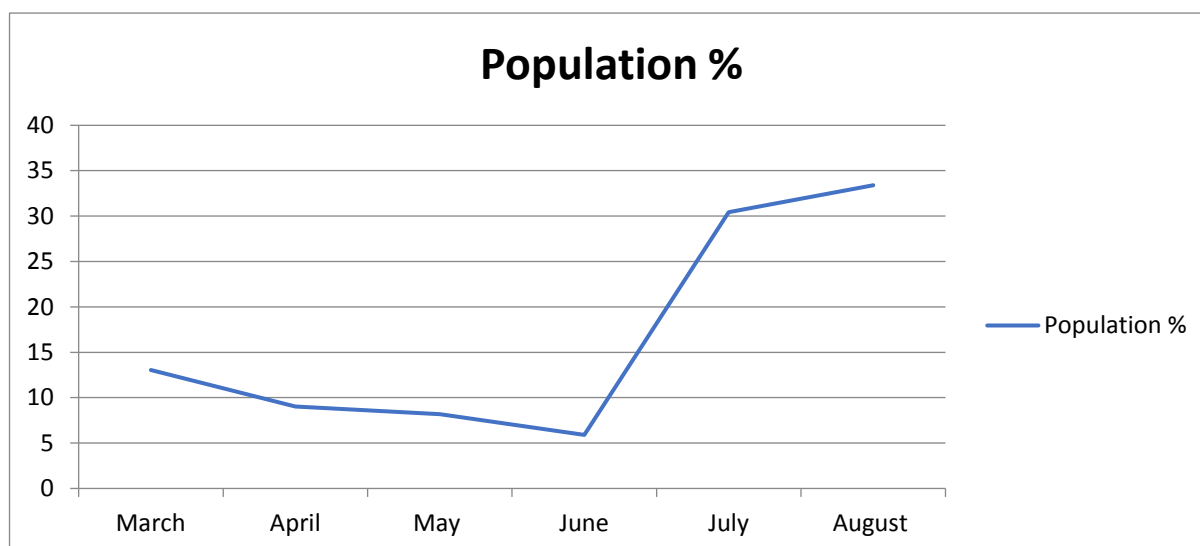


Figure 1. Relative abundance of termites from the months March to August

Discussion

The analysis of the collected samples of termites from the three tehsils of District Mianwali provides information about the distribution of different species of termites in different habitat and also their abundance ratio in different months. In the present study, by analyzing the collected samples, five termite species, *Coptotermes heimi*, *Microtermes mycophagus*, *Odontotermes obesus*, *Microtermes obesus*, *Odontotermes guptai*, were identified. In past very few studies have been conducted on the diversity of the termite species in Pakistan. Four species of termites, *Microtermes mycophagus*, *Microtermes unicolor*, *Microtermes obesi* and *Ereterme sparadoxalis* were reported from the cotton fields of Multan [9]. From the wheat field of Bahawalpur, *Microterme sobesi*, *Microtermes mycophagus*, *Odontotermes guptai* and *Eretermesparadoxalis* were reported [10, 11]. Data on diversity indices regarding abundance of termites for the first time was provided by Akhtar and Sarwar in 1993 [7]. In the present study, we found *C. heimi*, the most abundant specie, in contrast to the study conducted in Bahawalpur, where the specie *M. mycophagus* was the most dominant than other species [12].

Present study describes that most of the area of Tehsil Piplan is sandy so there is less number of termites as compared to Tehsil Mianwali, with fertile soil. Covering of the

ground by the crops, protects the ground and reduces the evaporation of water and increases the humidity of the soil and it is the main factor for providing the habitat for termites [13]. Closer to river Indus and salinity of the soil is not favourable for termites so the density of termite's population is also low in Tehsil Esa Khel than Tehsil Mianwali. Termites are found as decomposers in tropical regions and areas with thick vegetation [14]. Due to availability of thick vegetation, the activity of termites as pests was found maximum in Tehsil Mianwali of District Mianwali than the other two tehsils i.e., Tehsil Piplan and Tehsil EsaKhel.

During the termite collection, *C. heimi*, *O. besus*, *O. guptai*, *M. mycophagus* and *M. Obesus* were species, causing damage to wooden structures in houses, stored timber, paper, dead portions of living plants, dead plants, fire wood, soil of grounds, weeds and other cellulose containing materials. Many studies have been conducted to show the decomposing role of termites. It is reported that termites are more important decomposers of wood than fungi [15].

We found maximum numbers of termites in the months of July and August. In July and August, the increased pest activity was observed due to humid and warm environment and heavy rainfall [12]. The relationship between humidity and termites is positive while the atmospheric temperature

has negative effect on termite's abundance. [16].

Conclusion

The high density population of termites is associated with the environmental factors of the specified area, which accelerate their reproduction and growth. This study provides useful information about biodiversity of termites in the district Mianwali. It is illustrated that diversity of termites was greater in Mianwali. The present study will be helpful in understanding the biodiversity and pest activity of different termite species in Pakistan.

Authors' contributions

Conceived and designed the experiments: T Hussain & ME Babar, Performed the experiments: K Fatima, Analyzed the data: F Manzoor, B Bano, Contributed materials/analysis/ tools: F Manzoor, K Fatima, S Zahoor, S Mustafa & B Bano, Wrote the paper: K Fatima, S Mustafa, B Bano & T Hussain.

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