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***Research article***

# ON ABUNDANCE OF SOIL ACARINES AT FOREST FLOOR IN SUKNA RANGE OF MAHANANDA WILDLIFE SANCTUARY, WEST BENGAL, INDIA

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**ABSTRACT:** Sampling with monthly interval was conducted at two sites of Sukna forest range in the foothills of Darjeeling Himalayas. Peaks of abundance were observed during post-monsoons and the minima were recorded during the summer. One-way ANOVA revealed no significant difference between the sites. Soil temperature renderd statistically significant negative impact on abundance while the moisture exhibited significant positive effect at one site. Oribatid mites were the most abundant group of soil acarines followed by mesostigmata.
**Key words:** Soil acarines, edaphic factors, forest floor

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## INTRODUCTION

Soil acarines are often found to be the largest constituent of soil microarthropods and they are known to play very significant role in the dynamics of edaphic environs [1, 2, 3, 4, 5]. Various aspects on diversity and ecology of soil acarines have been addressed by a number of workers. Altitudinal pattern of distribution of soil acarines, specifically oribatid mites in Darjeeling Himalayas, was studied by Moitra *et al.* [6]. Rutigliano *et al.* [7] investigated the effect of experimental fire upon soil fauna. Bokhorst *et al.* [8] studied the impact of mosses and shrubs on the soil dwellers in a forest floor. Regional variation of soil microarthropods including acarines in a part of northern plains of Bengal was investigated by Sarkar *et al*. [9].

The current work was taken up to address the dearth of data on ecology of soil acarines in the foot-hill region of the Darjeeling Himalayas. The study taken up is expected to provide basic data on fluctuation of abundance and impact of edaphic factors on acarine populations that could be used as reference for future studies or biomonitoring the region.

## MATERIALS AND METHODS

Five plots with 1$m^2$ area were selected. Three samples from every plot were collected with a monthly interval. A cylindrical steel holder and a stainless steel core with 5 cm internal diameter and 5 cm depth were used for soil collection [10]. Tullgren funnel apparatus modified by Macfadyen [11] was used for the extraction of soil fauna. This extraction process was run from 3 to 7 days depending upon the moisture content of soil.

The content of each tube was poured carefully into a petridish and microarthropod groups were separated using needles and fine camel hair brush. They were preserved in tubes with 80% alcohol. Sorting and counting of the microarthropods were done using a wide field stereoscopic microscope with 64x magnification.

Physicochemical factors recorded during the present study included soil temperature and moisture. Soil temperature was recorded with a soil thermometer during the collection of soil sample. Soil moisture was estimated by following the method suggested by Dowdeswell [12].

Logarithmic transformations of data were made for statistical analyses whenever needed.

### Collection sites

The sites selected for sampling are located at Sukna – a part of Mahananda Wildlife Sanctuary located at the foot hill region of the Darjeeling Himalayas in the subdivision of Siliguri. Macroflora at the sampling sites included *Tectona grandis* (Verbenaceae), *Shorea robusta* (Dipterocarpaceae), *Bauhinia* sp. (Fabaceae), *Saraca indica* (Fabaceae), *Ailanthus excelsa* (Simaroubaceae) etc.

**Site-I** (Elevation: 742 ft, Location: 26°38′34.74″N, 88°21′15.88″E): Located at the eastern side of the National Highway 55, 200 m away from the road.

**Site-II** (Elevation: 732 ft, Location: 26°48′29.32″N, 88°20′57.34″E): Located at the western side of the National Highway 55, 200 m away from the road.

## RESULTS

At site-I soil temperature ranged from 14.1°C to 28.5°C while moisture varied from a minimum of 14.03% to 32.09% (Figure 1).

Minimum temperature recorded at site-II was 11.3°C and the maximum was 27.5°C and the soil moisture ranged from 13.45% to 31.56% (Figure 1).

### Abundance of soil acarines:

Numerical abundance of soil acarines at site-I ranged from 345 individuals to 1925 individuals and at site-II, minimum was 312 and maximum was 1557 (Table 1). Summary of the numerical data is given at table 1. There was no statistically significant difference between the population abundances of the sampling sites as the one-way ANOVA suggested; further, the Tukey test showed no significant difference between the means of abundances (Table 2).

### Site-I

Abundance of acarines ranged from 23 to 128.33 /core at this site while other microarthropods were fewer in number ranging from 4.67 to 57.27 individuals / core. Abundance tended to increase during post-monsoon season and exhibited a fall during the summer (Figure 2). Abundance of oribatid mites was highest among soil acarines and microarthropods as well. Their numerical abundance ranged from 14.27 to 80.13 per core (Figure 4). Mesostigmatids were the second abundant group of acarines that varied from 2.53 to 54.13 individuals /core (Figure 4). Relative abundances of oribatids and mesostigmatids were high whereas other two groups of acarines – prostigmata and astigmata exhibited less abundance (Figures 4, 6).

### Site-II

Oribatids ranged from 78.6 to 13.8 /core while Mesostigmatids varied from 1.4 to 48.13 /core at this site. Other two orders of acarines were few in number. Total soil acari reached a maximum of 103.8 /core to as low as 20.8 /core. Other soil microarthropods showed a peak of 49.07 /core and minima of 2.73 /core (Figures 3, 4). Like site-I, abundance exhibited a hike during post-monsoon season and a decline during the summer (Figure 3). Relative abundance of soil oribatids (64.3%) was highest among soil acarines followed by mesostigmatids (33.4%) (Figure 7).

### Impact of soil temperature and moisture:

Negative impact of soil temperature on population of acarines was prominent at the sites. Negative correlation between the temperature and the population was significant ($p<0.05$). Impact of soil moisture however was not clear though there were positive correlation at all the sites but it was significant only at site-II (Table 8). Regression equations taking acarines population as response and soil temperature and moisture as variables have been given in Table 4.

**Table 1: Summary of numerical data of soil acarines collected from different sites.**

| | Minimum | Maximum | Median | Mean | SD | SE of mean |
|---|---|---|---|---|---|---|
| Site-I | 345 | 1925 | 988 | 976.2 | 439.2 | ± 73.2 |
| Site-II | 312 | 1557 | 874.5 | 867.6 | 368.8 | ± 61.5 |

(SD = Standard deviation; SE = Standard error)

**Table 2: One-way ANOVA and Tukey test on abundances of acarines at two sites.**

Analysis of Variance for ACARI

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| SITE | 1 | 0.196 | 0.196 | 0.81 | 0.371 |
| Error | 70 | 16.961 | 0.242 | | |
| Total | 71 | 17.157 | | | |

| Level | N | Mean | StDev |
|---|---|---|---|
| S-I | 36 | 4.0610 | 0.5085 |
| S-II | 36 | 3.9566 | 0.4754 |

```
Individual 95% CIs For Mean
Based on Pooled StDev
----+---------+---------+---------+--
         (------------*------------)
(------------*-----------)
----+---------+---------+---------+--
  3.84      3.96      4.08      4.20
```

Pooled StDev = 0.4922

Tukey's pairwise comparisons

Critical value = 2.82

| | S-I |
|---|---|
| S-II | -0.1270<br>0.3358 |

**Table 3: Correlation analysis between soil acarines, soil temperature and moisture at the sampling sites.**

**Correlations: Site-I (Acari, Temp, Moist)**

| | Acari | Temp |
|---|---|---|
| Temp | -0.490<br>0.002 | |
| Moist | 0.323<br>0.055 | -0.180<br>0.293 |

Cell Contents: Pearson correlation
P-Value

**Correlations: Site-II (Acari, Temp, Moist)**

| | Acari | Temp |
|---|---|---|
| Temp | -0.436<br>0.008 | |
| Moist | 0.344<br>0.040 | -0.172<br>0.315 |

Cell Contents: Pearson correlation
P-Value

**Table 4: Multiple regression equations taking abundance of acarines as response and soil temperatures and moistures as variables.**

The regression equation at S-I :
Acari = 3.15 - 0.424 Temp + 0.336 Moist

The regression equation at S-II :
Acari = 2.80 - 0.342 Temp + 0.357 Moist

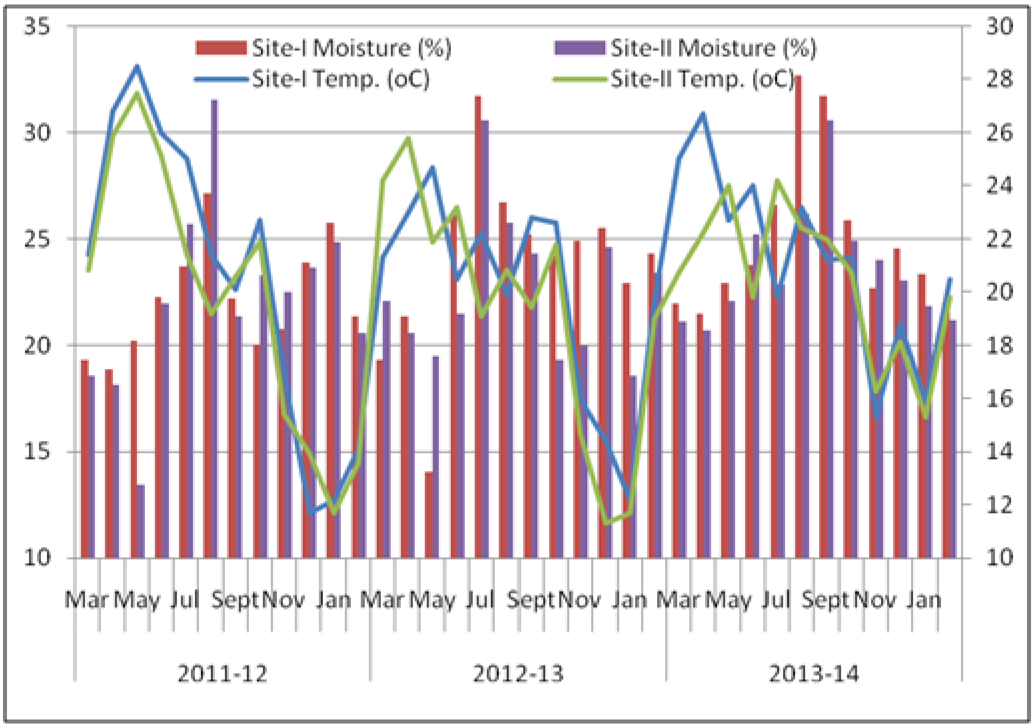


**Figure 1: Soil temperature ($^o$C) and moistures (%) as recorded during the collection period at site-I.**

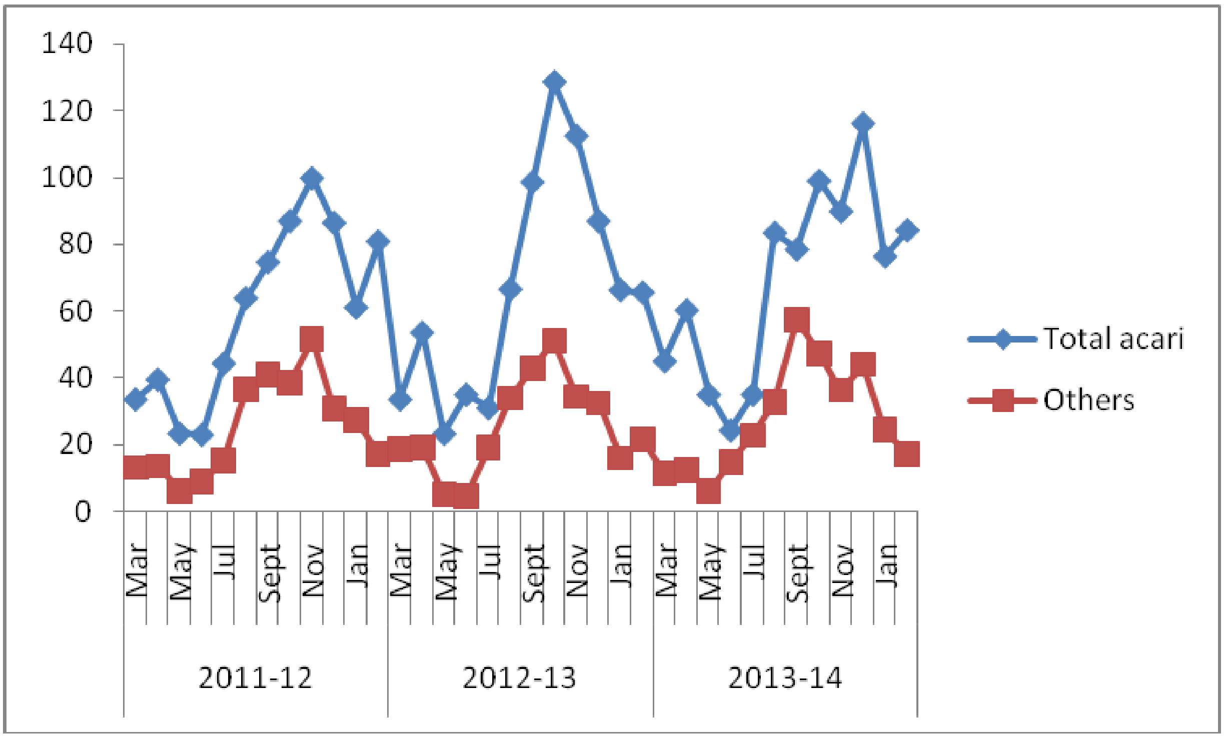


**Figure 2: Fluctuation of numerical abundance of soil acarines and other microarthropods at site-I.**

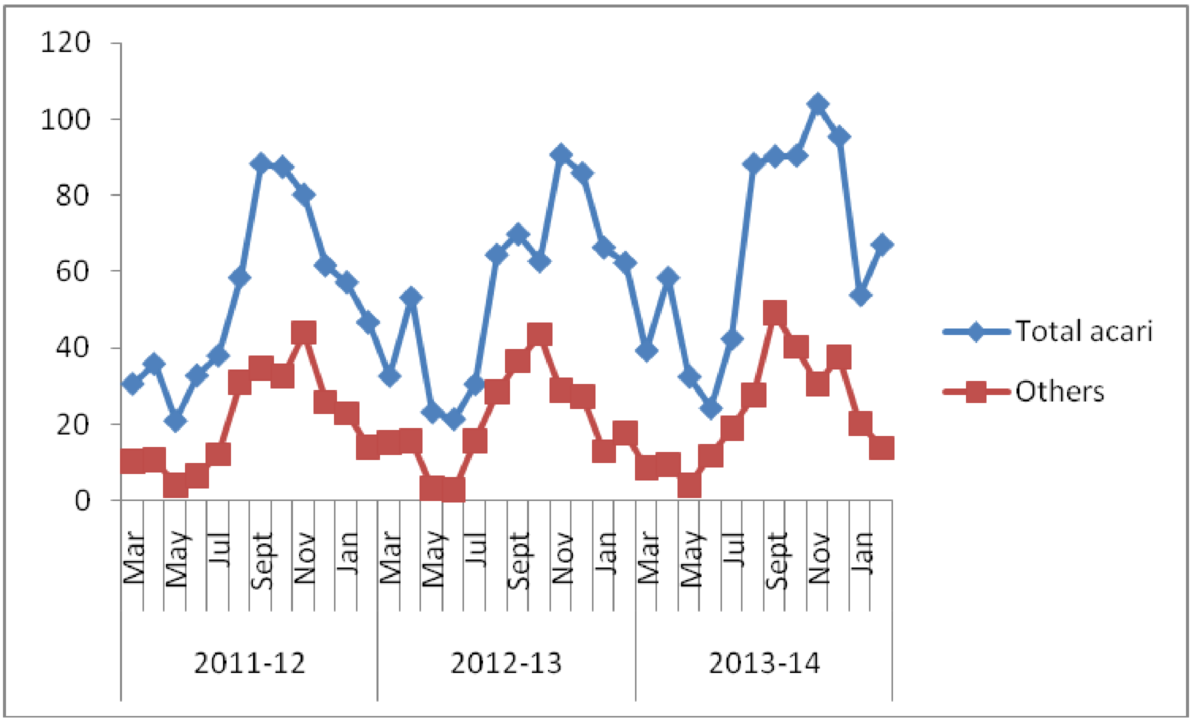


**Figure 3: Fluctuation of numerical abundance of soil acarines and other microarthropods at site-II.**

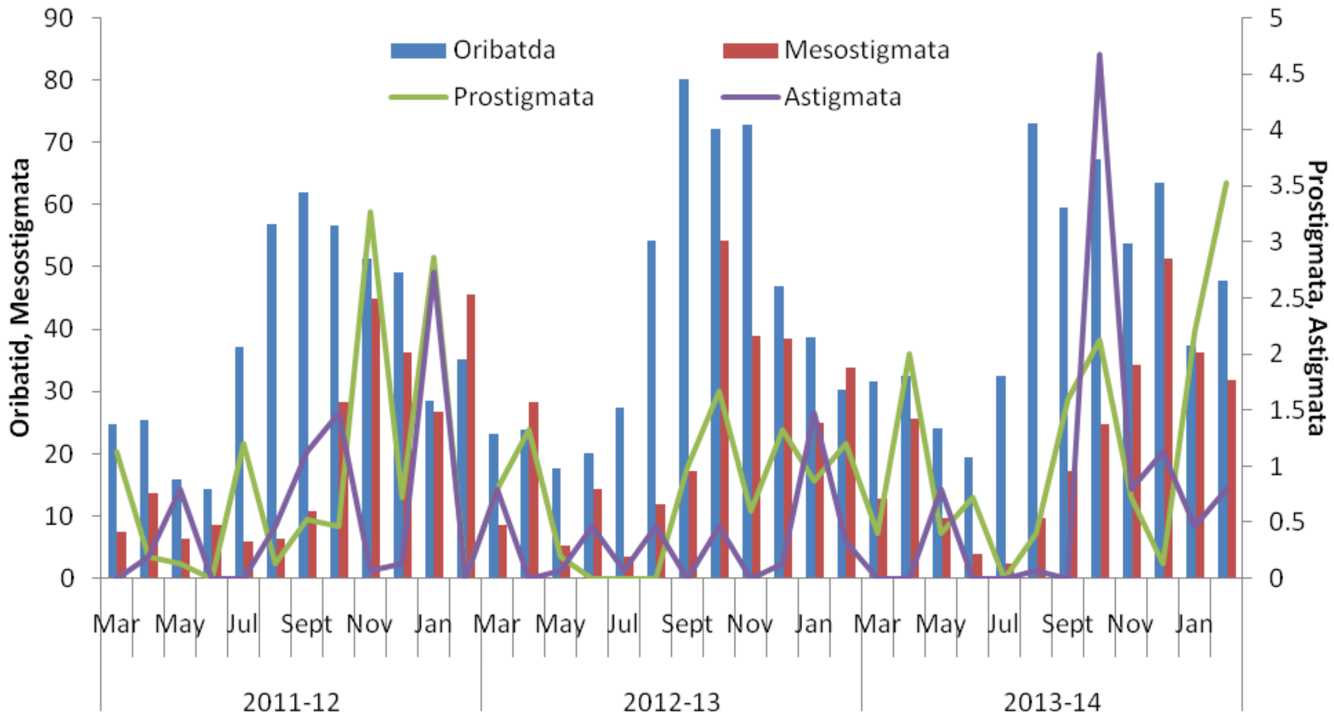


**Figure 4: Fluctuation of numerical abundance of different groups of soil acarines at site-I.**

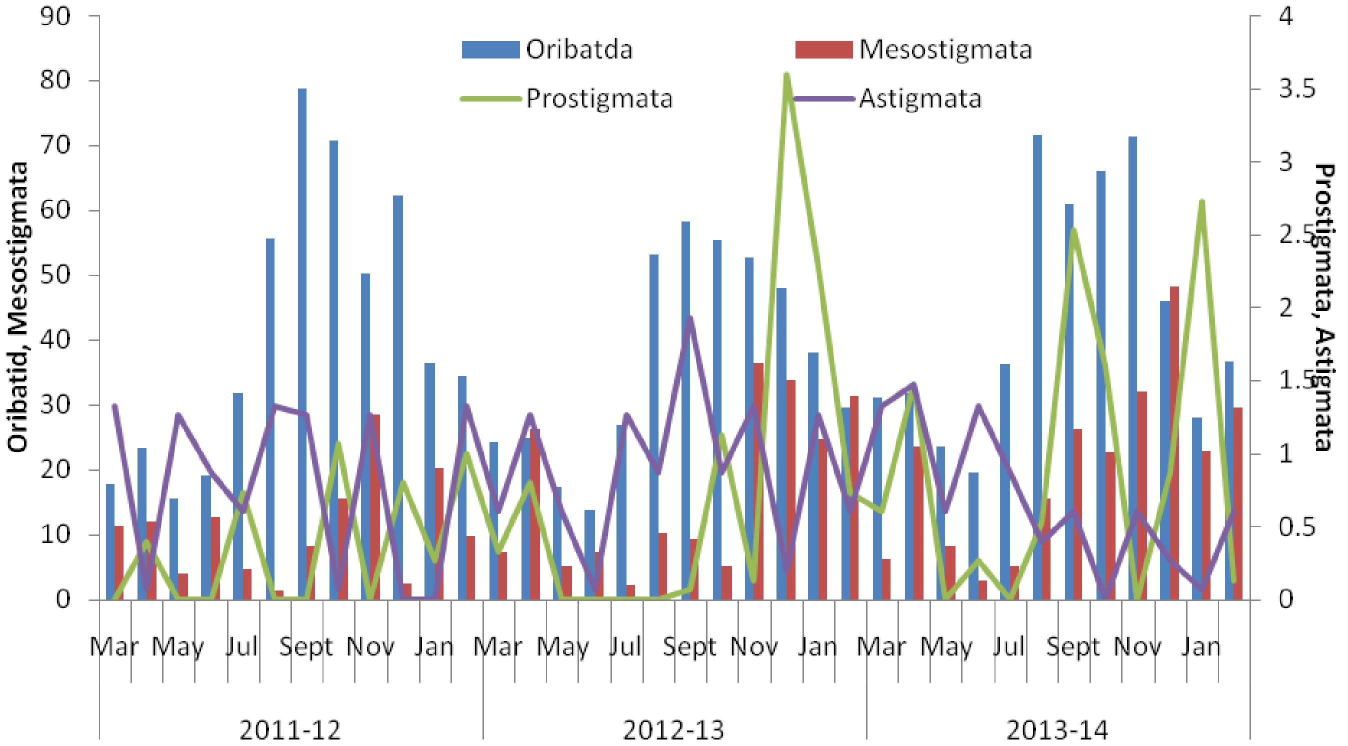


**Figure 5: Fluctuation of numerical abundance of different groups of soil acarines at site-II.**

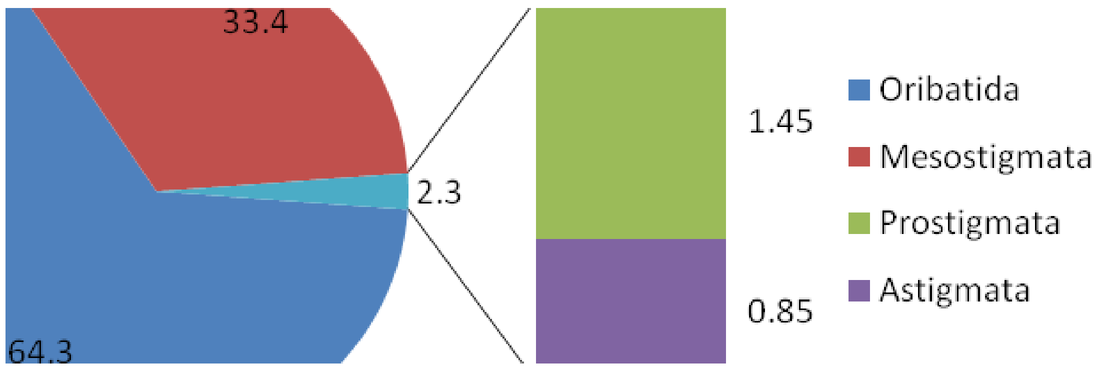


**Figure 6: Relative abundance (in %) of different groups of soil acarines at site-I.**

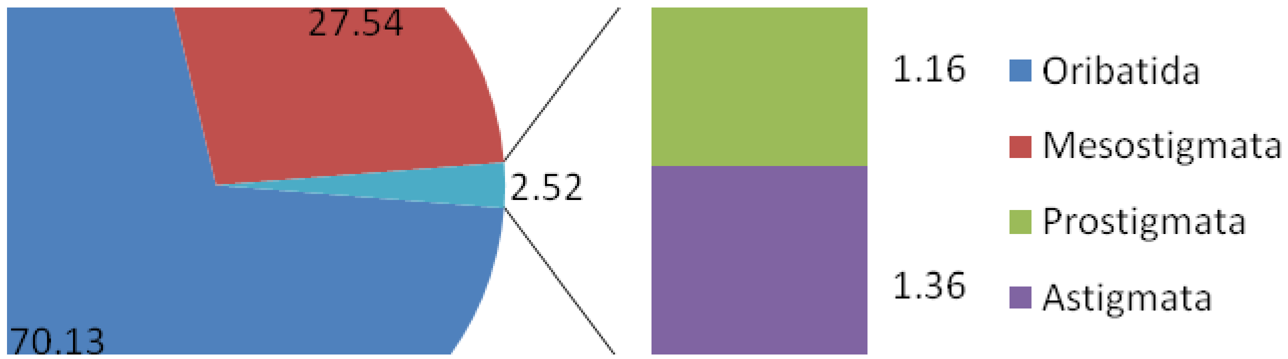


**Figure 7: Relative abundance (in %) of different groups of soil acarines at site-II.**

## DISCUSSION

The abundance was within the normal range as per the earlier reports obtained from the works conducted at West Bengal and other parts of India [6, 13, 14, 15]. At both the sites, greater abundances of soil acarines and microarthropods as well, were observed during the post-monsoon and a fall in the abundance was observed during the summer. Similar observations were made by earlier workers like Bhattacharya and Raychoudhuri [16], Bhattacharya *et al*., [17]. In the adjacent hills of Darjeeling Himalayas however highest and lowest peaks were recorded during summer or pre-monsoons and winter or monsoons respectively [6]. Difference in normal temperature range, rainfall and slope of hills might have resulted in such variations. Oribatid mite was the most abundant group of soil microarthropods followed by collembolans at the sites. Mesostigmata was the second most abundant group of soil acarines. This observation goes with the reports made by workers like Bhattacharya and Chakraborti [2], Joy and Bhattacharya [18], Ghosh and Roy [19], Chitrapati and Singh [5], Moitra *et al*., [15, 20], Sarkar *et al*., [9].

## CONCLUSSION

The road running between the two parts of Sukna range appeared to have no or little impact in creating ecological or edaphological divisions in the area.

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