

Vegetational Diversity and Oribatid Mite Communities in a Grassland of Yokohama, Central Japan

by

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Introduction

It is for the last several years in Japan that oribatid mite communities have been actively investigated in connection with vegetations. These studies had various aims and were planned to find difference in oribatid communities among natural, semi-natural and artificial vegetations (AOKI *et al.*, 1977; HARADA *et al.*, 1977; MIYAWAKI *et al.* 1977; HARADA & AOKI, 1978; AOKI, 1978) to make comparison of oribatid communities in different altitudes (AOKI, 1976; FUJITA *et al.*, 1976) or to detect influence of road construction upon vegetations and oribatid communities (AOKI & HARADA, 1977; AOKI & KURIKI, 1978).

The present study was made from a viewpoint somewhat different from those of the studies mentioned above. The study area was restricted to a small grassland which, though limited in size, shows various vegetations depending upon degrees of trampling impact.

Before going further the authors wish to express our hearty thanks to Miss Yoshiko NOGUCHI for her assistance in the sampling of soil and in the counting of oribatid mites.

I. Method

The study area is a small grassland of about 60 × 80m square located near the southwestern corner of the campus of Yokohama National University. This new campus was established in 1966 and, before that time, it had been used as a golf links. The actual vegetation map is shown in Fig. 1, which was drawn for the dominant species. *Zoysia japonica* community (A), *Pennisetum alopecuroides* community (B), *Artemisia princeps* community (C) and *Miscanthus sinensis* community (E) grow on loam of almost the same condition, while *Oenothera biennis* community (D) grow on loam with small gravels. *Arundinaria chinensis* community and *Ambrosia artemisiaefolia* var. *elatior* community were excluded from our study, because the former undergoes an influence of tall, planted trees and the latter grows on the soil which was disturbed a few months ago.

The sampling was made on 18th August, 1976, in the five plant communities (A-E). In each community 4 samples of about 20 × 20cm square were taken to the depth of 5–10cm. The samples were immediately put in Tullgren funnels and the oribatid mites were extracted by irradiation of 40W electric bulbs for 3 days.

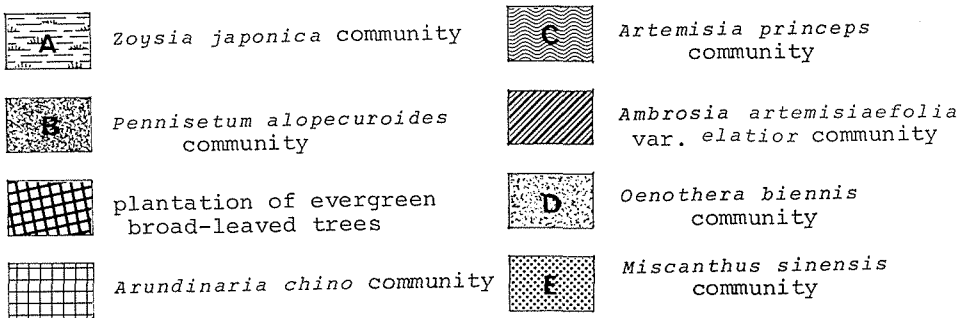
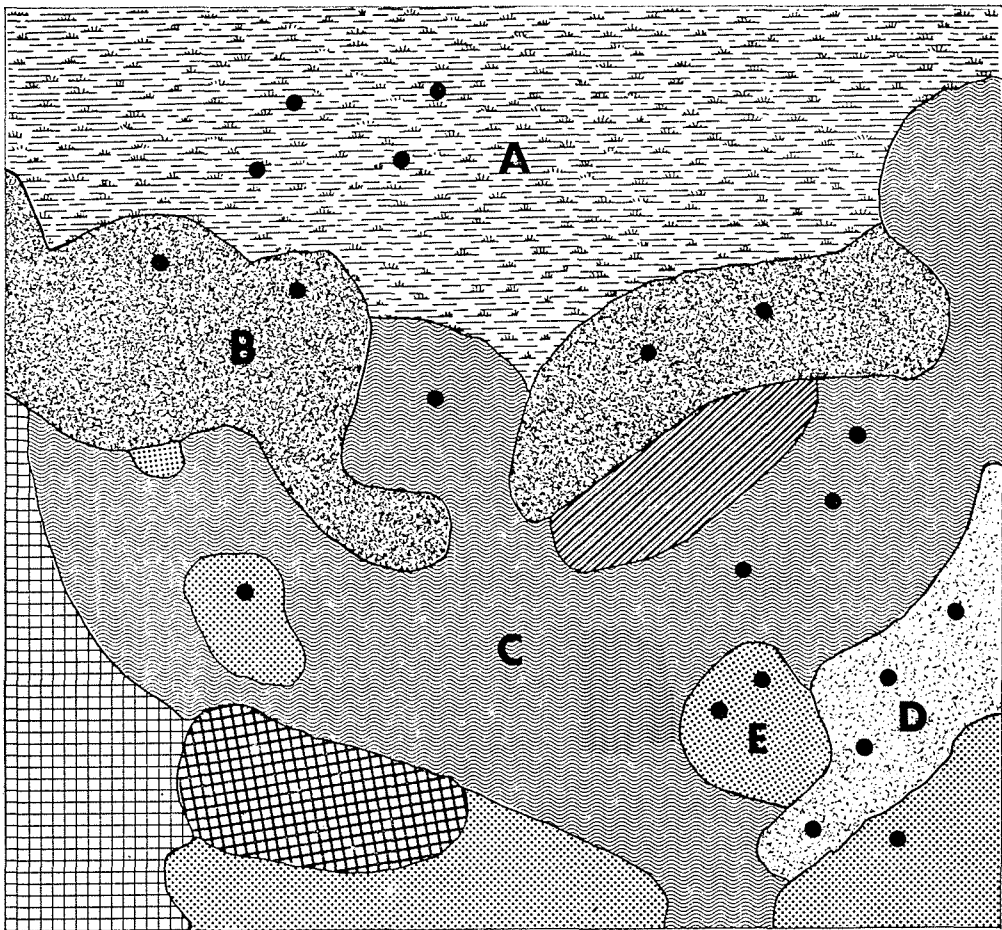


Fig. 1. Arrangement of the plant communities in the grassland investigated and the sampling points (●).

The soil hardness of the sampling points was measured by Yamanaka's soil hardness tester (type A, YH-62) at 3 cm depth from the soil surface beneath litter layer.

Table 1. Species composition of oribatid mites under the five different plant communities. The figures in the table show dominant value in percentage.

Plant community Oribatid mite	<i>Zoysia japonica</i> Community	<i>Pennisetum alopecuroides</i> Community	<i>Artemisia princeps</i> Community	<i>Oenothera biennis</i> Community	<i>Miscanthus sinensis</i> Community
<i>Gehyochthonius frondifer</i>	18.3	3.3			
<i>Striatoppia opuntiseta</i>	7.5	12.0	0.8		0.4
<i>Oppiella nova</i>		1.2	20.6	8.6	14.9
<i>Pergalumna duplicata nipponica</i>			11.9	3.2	26.6
<i>Eremobelba japonica</i>			6.3	3.2	6.7
<i>Scheloribates laevigatus</i>			3.2	6.1	2.9
<i>Suctobelbella naginata</i>			0.8	4.7	2.1
<i>Protoribates sp.A</i>			3.2	0.4	1.5
<i>Quadroppia quadricarinata</i>				19.1	6.3
<i>Eohyochthonius crassisetiger</i>				1.4	6.5
<i>Oppia sp.6</i>				0.4	4.8
<i>Suctobelbella sp.1</i>				7.9	0.2
<i>Rhysotritia ardua</i>				1.1	0.2
<i>Nothrus biciliatus</i>				0.7	0.2
<i>Tectocepheus velatus</i>	0.8	9.5	38.9	38.8	17.2
<i>Brachychthonius gracilis</i>	60.2	5.0	2.4	1.1	0.2
<i>Scheloribates latipes</i>	2.5	19.8	0.8	0.4	1.9
<i>Rostrozetes foveolatus</i>	7.9	38.4	4.8		0.8
<i>Epilohmannia pallida pacifica</i>	2.5	4.5	1.6		0.4
<i>Zygoribatula truncata</i>	0.4			0.7	
<i>Oppia sp.33</i>		2.5			0.2
<i>Peloptulus americanus</i>		0.8			0.4
<i>Oribatella meridionalis</i>		0.4			0.2
<i>Suctobelbella sp.2</i>		0.4			1.7
<i>Suctobelbella sp.3</i>			2.4	0.4	
<i>Brachychthonius hungaricus</i>			1.6		0.2
<i>Pergalumna altera</i>		1.7			
<i>Autogneta masahittoi</i>		0.4			
<i>Scheloribates rigidisetosus</i>			0.8		
<i>Oppia tokyoensis</i>				0.7	
<i>Palaeacarus hystericinus</i>				0.4	
<i>Oppia neerlandica</i>				0.4	
<i>Suctobelbella sp.4</i>				0.4	
<i>Suctobelbella sp.5</i>					2.1
<i>Hypochthoniella minutissima</i>					0.4
<i>Peloribates rangiroaensis asiaticus</i>					0.2
<i>Cultroribula lata</i>					0.2
<i>Suctobelbella sp.6</i>					0.2
<i>Fosseremus quadripertitus</i>					0.2
<i>Oppia sp.8</i>					0.2

II. Results and Discussion

(1) Species composition

A total of 40 species of oribatid mites were extracted from the 20 samples. The species composition and the abundance in percentage of each species are shown in Table 1. The table was made by the same method as in the phytosociological classification of the Zürich-Montpellier school. According to this table, *Gehypochthonius frondifer* and *Striatoppia opuntiseta* have a close connection with *Zoysia japonica* community (A) and *Pennisetum alopecuroides* community (B), which are considered to have received a hard trampling impact. On the contrary, *Pergalumna duplicata nipponica*, *Eremobelba japonica*, *Scheloribates laevigatus*, *Suctobelbella naginata* and *Protoribates* sp. A live under *Artemisia princeps* community (C), *Oenothera biennis* community (D) and *Miscanthus sinensis* community (E), which escaped a hard trampling impact. *Quadroppia quadricarinata*, *Eohypochthonius crassisetiger*, *Oppia* sp. 6, *Suctobelbella* sp. 1, *Rhysotrititia ardua* and *Nothrus biciliatus* are restricted to the plant communities D and E. *Tectocephus velatus* and *Scheloribates latipes* which show a wide geographical as well as ecological distribution were found under every plant community. It is interesting that the other cosmopolitan species, *Oppiella nova*, is lacking only in *Zoysia japonica* community.

(2) Dominant species

The dominant oribatid species which occupy more than 5% in number in each area are shown in Fig. 2. *Brachychthonius gracilis*, *Rostrozetes foveolatus* and *Striatoppia opuntiseta* are the dominant species common to A and B, but they do not become dominant in the remaining areas, C-E. However, the percentages of these three species are quite different between A and B. In *Zoysia japonica* community (A) *B. gracilis* becomes the most dominant species (60.2%), while in *Pennisetum alopecuroides* community (B), where the trampling impact is not so strong as in A, *R. foveolatus* occupies the first rank (38.4%). The remaining plant communities (C, D and E) of tall grasses outside the hard trampling impact have a quite different group of dominant species, i. e. *Tectocephus velatus*, *Oppiella nova*, *Pergalumna duplicata nipponica* and *Quadroppia quadricarinata*. These 4 species of mites occupy 71.4% in C, 66.5% in D and 65.0% in E. They seem to be the most common dominant species under the plant communities of tall grasses in Central Japan. According to MIYAWAKI *et al.* (1977), AOKI *et al.* (1977) and HARADA *et al.* (1977), two or three among these four oribatid species become dominant in grasslands dominated by *Miscanthus sinensis*, such as *Arundinella hirta*-*Miscanthus sinensis* community, *Solidago altissima*-*M. sinensis* community, *Youngia denticulata*-*M. sinensis* community, *Arundinaria chino*-*Miscanthus sinensis* and *Miscanthus sinensis* community.

It was not expected, however, that the most dominant species in *Zoysia japonica* community (A) under the strongest impact of trampling were the primitive oribatid species such as *Brachychthonius gracilis* and *Gehypochthonius frondifer*, occupying together 78.5% of total oribatids found there. Generally, the most dominant species under vegetation of short grasses are known to be members of

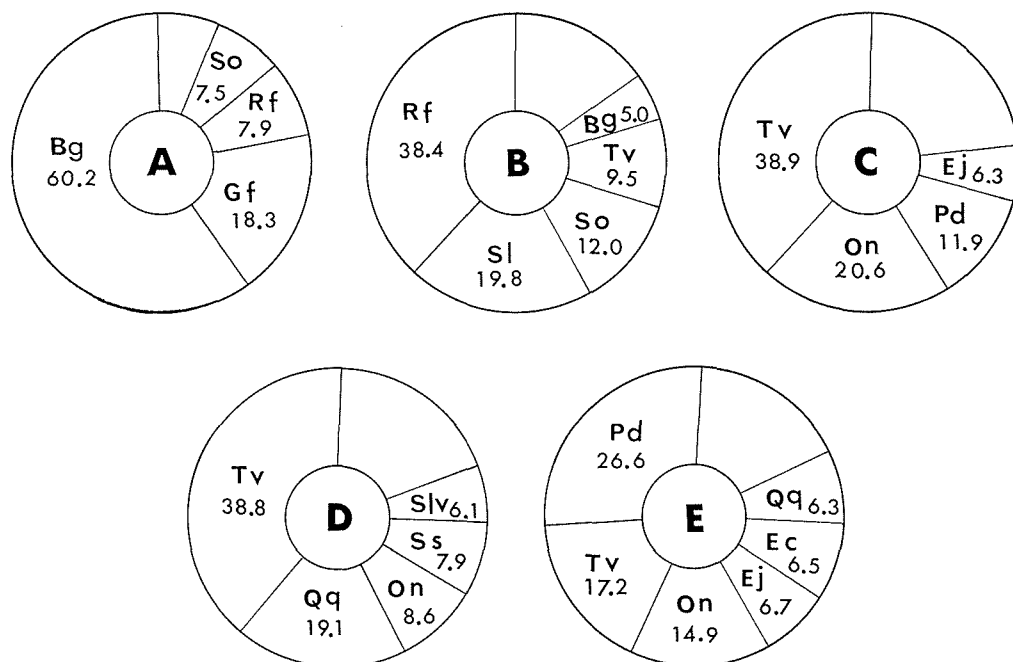


Fig. 2. Abundancy in percentage of the dominant oribatid species in each area. A: *Zoysia japonica* community, B: *Pennisetum alopecuroides* community, C: *Artemisia princeps* community, D: *Oenothera biennis* community, E: *Miscanthus sinensis* community, Bg: *Brachychthonius gracilis*, Ec: *Eohypochthonius crassisetiger*, Ej: *Eremobelba japonica*, Gf: *Gehypochthonius frondifer*, On: *Oppiella nova*, Pd: *Pergalumna duplicata nipponica* Qq: *Quadroppia quadricarinata*, Rf: *Rostrozetes foveolatus*, Sl: *Scheloribates latipes*, Slv: *Scheloribates laevigatus*, So: *Striatoppia opuntiseta*, Ss: *Suctobelbella* sp. 1, Tv: *Tectocephus velatus*.

Table 2. Hardness of soils under the five different plant communities. The measurements were taken at the 3cm depth by the soil hardness tester (YAMANAKA's type A).

Area	Plant community	Soil hardness (mm)
A	<i>Zoysia japonica</i> community	19.2 ± 1.1
		19.3 ± 0.9
B	<i>Pennisetum alopecuroides</i> community	16.7 ± 1.3
		17.7 ± 1.0
C	<i>Artemisia princeps</i> community	9.9 ± 2.1
		9.5 ± 1.7
D	<i>Oenothera biennis</i> community	12.5 ± 2.4
		13.0 ± 1.0
E	<i>Miscanthus sinensis</i> community	9.0 ± 2.4
		8.1 ± 2.4

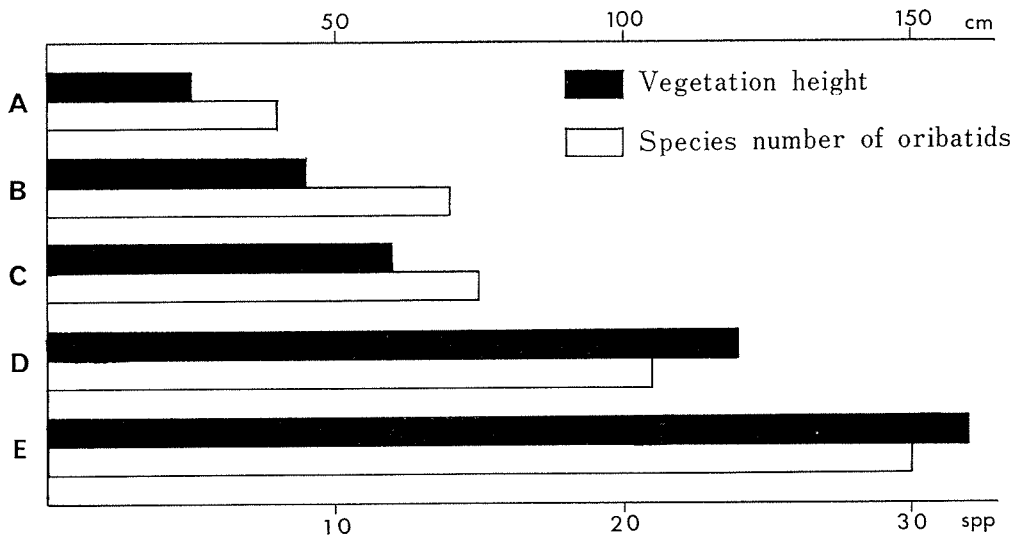


Fig. 3. Vegetation height and species number of oribatid mites (For the explanation of A, B, C..., see that of Fig. 2)

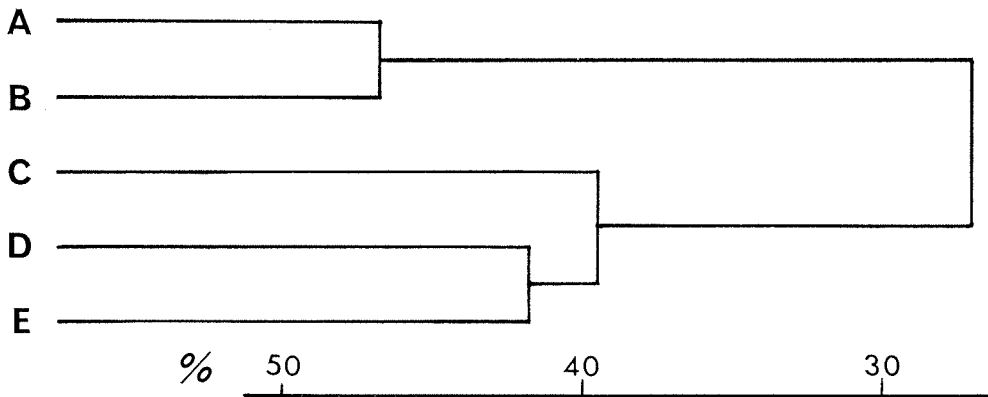


Fig. 4. A dendrogram showing similarity among the five oribatid communities by the JACCARD's coefficient of community.

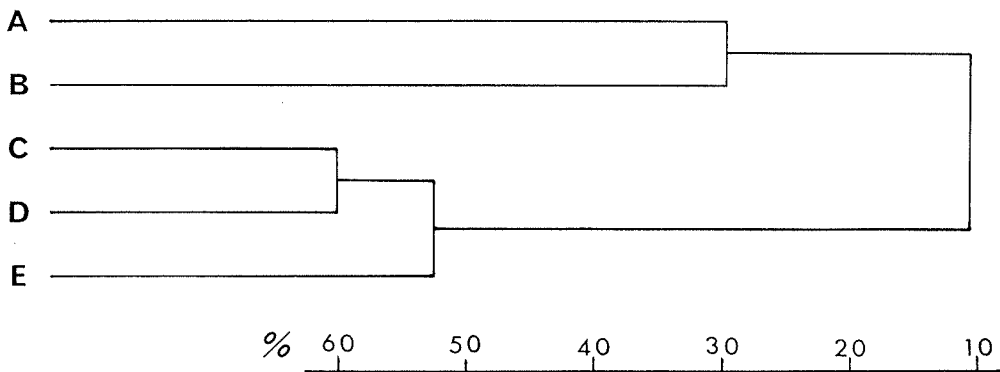


Fig. 5. A dendrogram showing similarity among the five oribatid communities by the WHITTAKER's percentage similarity index.

the genera *Scheloribates* and *Pergalumna*.

(3) Species number

The species numbers of oribatid mites are shown in Fig. 3 in relation to the vegetation heights of grassland communities. The vegetation heights in the areas from A to E are 15cm, 45cm, 60cm, 120cm, 160cm, and the species numbers are 8, 14, 15, 21, 30. The species number of the oribatid mites apparently increases in proportion to the vegetation height. In other words, the species number seems to be affected by trampling impact, because the vegetation height is known to increase as the trampling impact decreases.

(4) Similarity of the oribatid communities

A dendrogram showing similarity of the oribatid communities by the JACCARD's coefficient of community and that by the WHITTAKER's percentage similarity are shown in Fig. 4 and Fig. 5, respectively. According to the cluster analyses, the five oribatid communities (A-E) can be divided into two groups, namely A-B group and C-D-E group. The former group (A-B) is found under *Zoysia japonica* community and *Pennisetum alopecuroides* community, both of which are composed of prostrate or short grasses, receiving a hard trampling impact. On the other hand, the latter group (C-D-E) is found under the plant communities of tall grasses which almost escaped the hard trampling impact. Among the oribatid communities of this group, D is more similar to E by JACCARD's index (Fig. 4), while D is more similar to C than to E by WHITTAKER's index (Fig. 5).

Summary

The oribatid mite communities were compared among five different plant communities grown in a small grassland area in Yokohama, Central Japan. As the result of the arrangement of the oribatid species in a table by the same method as in phytosociological classification, several species groups of oribatids were found to be in close connection with the plant communities. The species number of oribatid mites increased in proportion to the vegetation height which was determined by degree of trampling impact. Difference in composition of dominant oribatid species and similarity among oribatid communities were also found to be closely related to the human impact of trampling.

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