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The Significance of Grazing on The Population Distribution of Soil Oribatid Mites

Hala M Abdel-Lateif
Department of Zoology, Faculty of Science, Tanta University, 31527 Tanta, Egypt
hala.basuni@science.tanta.edu.eg

Abstract

This study is a quantitative and qualitative analysis of the orbited population structure in two desert biotopes in relation to grazing and cysticercoids infection. Variations in the abundance and relative contribution of different oribatid species within each of the two chosen biotopes were found to be markedly significant. This indicated that local environmental variations had a substantial role in determining the oribatid population character. Not all the species of oribatid mites reported as intermediate hosts are equally suitable for the development and transmission of the tapeworms. Of seven mite hostsanoploce phalidcestods in Egypt, *Scheloribateslae vigatus* was the chief intermediate host as these were found to have the highest incidence of cesticercoids in nature. The incidence of infection is clearly high in March. No infection cases could be detected among relatively small-sized species as well as the primitive ones. Both grazing and cesticercoid infection are considered among the main biotic factors controlling oribatid population in grazed desert biotopes. On the other hand, the obtained figures of the species diversity and equitability in the grazed biotope showed a marked decrease during the late period of grazing, however in case of ungrazed biotope an increase of both indices could be observed during that time. The vertical distribution patterns of oribatid mites were found to be closely associated with the functional relationships between different trophic levels in the ecosystem. In grazing management system the population of oribatid mites was spontaneously tended to be more decline rather than stable age distribution, however in ungrazing plots the reverse is true. In conclusion, the effective monitoring of grazing processes is an important component of sustainable management systems and much research has been undertaken to develop both suitable indicators of land health and tools to monitor changes in land condition.

Key words

Grazing management; Oribatid mites; Parasitic vectors; Vertical distribution;

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Introduction

Grazing is the dominant land use, and over-grazing shifts plant species composition and adversely affects soil characteristics such as infiltration, water holding capacity, bulk density, soil organic carbon content and nutrient capital and cycling, variables that are frequently included in simple measures of soil condition (Tong wayand Smith 1989). Effective monitoring of these processes is an important component of sustainable management systems and much research has been undertaken to develop both suitable indicators of rangeland health and tools to monitor changes in rangeland condition (Karfs et al. 2000). Beyer et al 2011 assessed the relationship between grazing on soil characteristics and mite communities in a semi-arid savanna of northern Australia. They concluded that Season had a significant impact on total soil mite abundance and diversity, whereas grazing treatments had no impact on soil mites. Only two morpho-species, one each from the families Cunaxidae and Stigmaeidae, decreased in abundance as a result of grazing. Increased moisture levels in the wet season were associated with increased total nitrogen and the highly mobile nitrate. Changes in mite abundance and diversity reflected these changes in levels of nitrogen and it is possible that increasing total nitrogen availability and soil moisture is a determinant of mite abundance. Herbivores (such as grazing livestock) also have a significant influence on soil structure and condition as a result of biomass consumption, urination, defecation, and compaction of the soil. These processes all influence the availability of water and nutrients, which in turn influences plant community structure, soil quality and health (Clapper ton et al. 2002).

Several species of oribatid mites were discovered to be vectors of tapeworms that infect economic farm animals. Stunkard (1937),was the first who elucidated the oribatid-anoplocephaline cycle, stated some oribatid mites (e. g. *Galumna*sp.) to act as intermediate hosts for the tapeworm *Monie ziaexpansa*. Also Kates and Runkel (1948) 'differentiated the vector populations from pasture and forest soils. Moreover, the recognition of the oribatid mites from the veterinary point of view has attracted the attention of several investigators such as Stoll (1938); Narsapur (1976 a, b & 1978); Narsapur and Drokopic (1979) and Bayoumi et al. (1981). On the other hand, the ecological investigation on the soil mite communities in pastures has received little attention (Aoki, 1962; Balogh et al., 1965; Nakamura, 1973; Bayoumi et al., 1981 and Ghabbour and Hussies, 1982). It is worth to mention that x, 11 these studies have dealt only with counting the individual numbers in the investigated areas. However in Egypt, satisfactory ecological investigation concerning the grazed desert ecosystem has so far not been conducted. Bayoumi et al. 1981 and Al-Assiuty and Seif 1995) introduced an attempt in view of short term investigation trying to open the door for this line of study. Also the same authors indicated that the possibility of mite infection with parasite and infection of grazed animals with larvae of cestodes from intermediate host depends mainly on the intensity of contacts between these populations. Al-Assiuty and Seif (1995) studied the combined effect of parasitism and desiccation on mortality of soil-dwelling mites from ungreased and goat grazed fields. They concluded that the ability of mites to withstand desiccation is significantly influenced by parasitism. It is well known that the study of the distribution ecology among individuals of different species as influenced by biotic factors is one of the essential trends in ecological researches. Thus, the aim of this study was to assess soil mites as potential indicators of soil health by measuring the impact of grazing on soil oribatid mites distribution in two isolated areas (grazed and ungrazed areas) of the western Mediterranean coastal land of Egypt. The present study also aims to throw some light on the influence of grazing and cesticercoid larval infection on the population distribution of oribatid mites in two desert biotopes.

Materials and Methods

The study area

Field experiment was laid out in a true replication manner, since it was conducted at three pairs of independently areas (grazed and ungrazed areas) of the western Mediterranean coastal land of Egypt. The first three sites (grazed area) at Omayedregion (about 83 Km. west of Alexandria) and the second, three sites (ungrazed) at Burg El-Arab region (about 40 Km west of Alexandria). The study areas belong to the dry arid climatic zone of Koppen's classification system (after Trlewartha, 1964). The soil in both study areas is sandy. These areas are characterized by one rainy season. Precipitation occurs mainly in the period between October and February. The vegetation at Omayed areas is differentiated into groups dominated by *Asphodel us microcarpus* , *Echiochilon frutiswm, Plantagaalbicans* , *Anabasis articulate* and *Atractyliscarduus*. Other important species are *Thymelaeahirsuta, Gymnocarpos docandrum and Helianthemumlippii* which in some vegetation groups share dominance with one of the dominant species (El Kady, 1980). At Omayyad the land was grazed by farmyard animals (sheep and goats) during (December 2012 - May 2013). However, Burg El Arab study area has the same vegetation but has not been used for grazing since 1978.

During the period of investigation, which extended from Mar. 2012 till Feb. 2013, air temperature above one meter of the soil surface, soil temperature at the depths of 3, 9 and 15 cm were recorded (Table 2). The mean rain fall was about 55 mm during the year 2012/2013. (Mainly in December and January). The organic contents are significantly variable in both studied areas; however the monthly fluctuations of the organic content in the same area are not significant (1).

Sampling

Samples of soil were taken monthly during a period of one year (March 2012-Feb. 2013). Ten samples from each site were collected at random (a total of 30 samples) by means of cuboidal metal sampler (10 x 10 x 18 cm). Each core was divided into three equal subcores (0 - 6, 6 - 12 and 12 - 18cm). Mites were extracted from the soil samples by dry heat extraction in modified Berlese funnels for 7 days and collected into distilled water and stored in 70% isopropyl alcohol and ethylene glycol (9:1). The extracted mites were sorted using a stereo microscope .The collected mites were cleared using a mixture of 70% ethyl alcohol and lactic acid (Balogh, 1972). The mites were all mounted on microscopic slides and viewed under high magnification. Only adults were identified to species. Taxonomic works carried out according to Ghilarov and Krivolutsky (1975), Balogh and Mahunka (1983), Balogh and Balogh (1992), Pe´rez-In˜igo (1993, 1997) and Subı´as and Arillo (2001).Cesticercoid examination was carried out as mentioned in Al-Assiuty and Seif (1995).

Data analysis

Dominance classification and concentration of dominance were evaluated according to Engelmann (1978) and Odom (1971). Species diversity values were evaluated using Shannon-Whiner Index (H') and equitability (E). The population age distribution was evaluated using the age pyramid as the percentage according to Pielou (1974) in the different age classes of the total oribatid mites. As well as the degree of skewiness of the frequency distribution curve according to Al-Assiuty (2014) was assessed. Vertical distribution of soil oribated mites was evaluated by estimation of the mean depth and depth deviation according to Usher (1971).

Results

Species composition

A total number of 21 oribatid species was recorded from the two biotopes (Table 3), of which 15 spp occurred in grazed area and 11 spp in ungreased one. However, the number of shared species was 5 spp and that of the species restricted to grazed biotopes was 10 spp whereas 6 spp were found only to be restricted in the ungreased biotope. Thus the qualitative affinity of the oribatidmite species composition in the two selected localities was low (0.238). The total number of dominant species in grazed area occupied about 47% of the total individual number of all species in this area. However in ungreased such ratio being high 71.4%, consequently the concentration of dominance being higher in grazed than those of ungreased sites.

Cesticercoid infection

Concerning the susceptibility of different mite species towards infection however, it should be mentioned that 7 spp. namely: *Scheloribatesconfundatus; Scheloribateslaevigatus; Scheloribatespallidulus; Zygoribatulacognata; Zygoribatulaexarata; Xylobateslophotricus; Galumnaflabellifera* were found to be infected with cysticercoids larvae (table 4). As to the relative contribution of the recorded seven oribatid hosts among the total oribatid species, it was found that 5 spp. of which were dominant, however both *Scheloribatespallidulus* and *Zygoribatulaexarata* were influent ones. The percentage of infectiveness during the period of investigation was shown by individuals of *Scheloribateslaevigatus* (73%); *Scheloribatesconfundatus* (46%); *Galumnaflabellifera* (42%) *Zygoribatulacognate*(31%); *Scheloribatespallidulus* (16%); *Xylobateslophotricus*(14%) then come *Zygoribatulaexarata* (3%). From the obtained data of vertical distribution and the susceptibility for infection it was observed that there is a strong correlation between the infected species and their mean depths (Table 5), so the infected species prefer the uppermost stratum especially during the grazing period.

Population density

Comparing the annual curves of the total population densities of the oribatid mite fauna in both studied habitats, no significant difference in the general patterns of the presented curves (Fig. 5)could be seen, this may be due to the fact that both biotopes are related to the same type of major habitat (desert ecosystem). However, the grazed biotope population curve showed the greatest values of densities during all year round. Also the amplitude of population density curve of grazed biotope was markedly more than that in case of ungreased one.

Species diversity and concentration of dominance

Species diversity and concentration of dominance are very much influenced by the functional relationships between the different recordrdoribatid spp. Species diversity and equitability figures in the grazed area showed a marked decrease during the late period of grazing (May/September), but in the case of ungreased area the maximum values of species diversity, equitability were seen at that period (Figure 3 and 4).

Vertical distribution

No regular variation in the vertical distribution in both studied biotopes was observed. Table 3 it can be noticed that the oribatid mite fauna in grazed ecosystem preferred(0 – 9 cm)below the ground surface specially during grazing period (Dec.- May) where the obtained mean depths were relatively low ranging between 6.51 cm in March and 7.67 cm in December, as compared with the results of ungreased biotope. As concerns the seasonal intensity of the vertical movement of the total oribatid mite fauna in both studied areas, a marked difference could be observed during grazing months (Table 5).

Population age distribution

In the case of grazing managed system the population age distribution (Fig 6) indicates uneven distribution for the different classes. Moreover, the frequency distribution curve of the different age classes showed negative skewness (-0.91) of maximum (-3).Thus the population was spontaneously tended to be more decline rather than stable age distribution. However in case of ungreased managed sites. The pre reproductive forms (larva, proto, deuto and tritonymphs) represent about 84% of the total oribatid individuals, this ratio was found to be more or less evenly distributed among different stages as well as the skewness of frequency distribution curve was +0.14 of maximum of (+3). Thus the population was spontaneously returning a more stable population

Discussion

I measured the effects of grazing treatments on soil physicochemical variables, soil mite diversity and abundance to examine any significant correlations between soil properties and mite assemblages. My hypothesis was that there would be strong seasonal decreases in mite abundance and diversity in the dry season, and that grazing would have impacts on soil physic chemistry with consequent reductions in mite diversity, though not necessarily total mite abundance. I found that the increase in moisture and total nitrogen (TN) associated with the wet season were the main correlates with mite community composition and both had a significant positive impact on total soil mite abundance and diversity. There was an increase in soil nitrate in the wet season, but this did not have a significant impact on mite community composition. In semi-arid lands, mite communities are associated with severely degraded shrubs as result of grazing and physical disturbance (Kin near and Tongway 2004).The present study suggests that there silent to physical degradation under these grazing regimes and do not undergo the degree of soil and faunal degradation with grazing evident in other published studies. There were significant changes in total mite abundance and diversity in response to the grazing treatments. This may be due to the effect of grazing on certain soil variables.For example even though there were statistically significant grazing effects on total soil nitrogen. This contrasts with other studies that have shown that soil mite abundance and diversity decrease under significant grazing pressure (Kay et al. 1999; Clapperton et al. 2002; Battigelli et al. 2003; Kinnear and Tongway 2004). However, in all these studies, significant and substantial changes to soil physico-chemical variables were also recorded as a result of the grazing regimes, including increases in bulk density. (Clapperton et al. 2002; Battigelli et al. 2003) and soil compaction (Kay et al. 1999) and greatly reduced organic matter, total nitrogen and aggregate stability (Kinnear and Tongway 2004).

Wallwork and Rodgrigues (1961) indicated that animal grazing greatly affects the abundance of oribatid species. On the other hand, the relative contributions of the oribatid mites fauna in both biotopes were found to be significantly influenced by grazing: this can be well illustrated from the obtained data.However in urgrazed area the dominant species represent a low percentage (27%). This result is in accordance with that of Edwards and Lofty (1969) who reported that fertilizer application might encourage multiplication of the fewer arthropod species. Although the ungrazed biotope was not subjected to grazing since eight years, yet few cases (about 3%) of ceoticercoid infections have been observed in case of *Scheloribateslaevigatus.* This may be due to human interferences, by adding the natural organic matter in adjacent fields and the infected cases may spread from neighboring areas or transported by means of birds. Bayoumi et al. (1981) suggested that the infected oribatid individuals in unused pasture may be transported from the adjacent used pasture bywind. On the other hand, in the grazed area, the incidence of infection is clearly high during March especially in case of the genus *Scheloribates*. This probably may be due to the fact that at that time the infective larvae became well developed to be detected after infection has occurred at early period of grazing. Narsapur (1976) stated that cesticercoid larvae which parasitize *Scheloribateslaevigatus* need 50 - 62 days for developing after exposure to tapeworm eggs. Also he indicated that the corresponding period in *Scheloribateslaevigatus* and other oribated mites in U S S R are 170 days and in Czechoslovakia is 150 days. As to the abundance of the population individuals in grazed biotope than that recorded in control area, this may be attributed to the presence of relatively large amounts of organic matter as nutrient material and improving the soil condition.In the present study, the highest abundance of the population individuals in grazed biotope than that recorded in control area may be attributed to the presence of relatively large amounts of organic matter as nutrient material and improving the soil condition.Nassar (1963), Edwards and Lofty (1969) Tadros et al. (1977), and Bayoumi et al. (1981) have concluded that there is a strong correlation between the amount of organic matter and abundance of soil mites. However, the great amplitude of population density curve, in case of grazed area, is probably due to the positive effect (increase oribatid populations) of grazing by providing the soil with organic matter as a result of defecation of grazer animals and negative effect (decrease of oribatid population) of the cesticercoid infection.Balogh et al. (1965) indicated that species with high values of constancy and dominance play a significant role in the biocenosis and under given circumstances they may become the most important intermediate hosts': anoplocephalidcestods. As a result of the present data it should be mentioned that overgrazing, promotes high abundance of many dominant oribatid species especially at early period of grazing (Dec. / Jan.). In other words, the maximum abundance of mites would be detected in period with high levels of moisture and organic matter. On the other hand, the local constancy figures of oribatid mite fauna in the two investigated biotopes behaved differently, since the grazed area showed the highest values. However, a high level of organic matter during summer would not be sufficient to bring about an increase in abundance of mites. So dropping in population densities in both habitats occurred during late period of grazing (May till Augst) is probably due to the low moisture availability. As well as other cofactor in case of grazed biotope, where at that time the dominant mite hosts of cesticercoids suffer from the developing larvae of anoplocephalidcestods which certainly affect.' the biology of mite hosts. Species diversity and concentration of dominance indices provide the best wayto detect and evaluate the effect of parasitism with cesticercoid on oribatid mites. It should be mentioned that the relative decrease of species diversity and equitability in the grazed area occuring during the late period of grazing (May/Sep.), may be attributed to the great reduction in the abundance of the most dominant species (species act as intermediate hosts) such as; *Scheloribatesconfundatus; Scheloribateslaevigatus; Zygoribatulacognata; Xylobateslophotricus* and*Galumnaflabellifera* due to the effect of the infection with developing cesticercoids. Nevertheless, at that time the population sizes of the uninfected co dominant species (*Epilohmnia c. cylindrica and Multiopiawelsoni)* were not affected in such proved habitat. On the contrary and in ungrazed biotope as seen from concentration of dominance (c) figures, the population density of *Epilohmannia c. cylindrica* and co dominant ones were greatly decreased, since (c) values showed their least figures during this time. From the results of vertical distribution, it can be suggested that five dominant oribatid species which are susceptible towards the infection with cesticercoid (feed on parasite eggs with grazing animal excrements) are the main reason behind the differences of vertical patterns showed in both habitat. Thus it can be indicated that the grazing had clear effect on the intensity of vertical movement of these organisms. From the obtained results, it is clear that the vertical distribution patterns of oribatid mites in both investigated biotopes is closely associated with the functional relationships between different trophic levels in the ecosystem.No infection cases could be detected among relatively small species. This agrees well with the results published by various investigators (Balogh et al., 1965; Wallwork, l970 and Bayoumi et al., 1981).

Denegri 1993 provided a list of oribatid mites acting as intermediate hosts of tapeworms. He concluded that *Scheloribateslaevigatus*was the species that demonstrated most susceptibility both natural and experimental to develop larval forms of tapeworms. Also the present data revealed that no species of the primitive oribatid mites was recorded as vector. This probably; due the insusceptibility for infection and or tot he feeding habits of their representatives. Hussien (1972) and Afify (2014) reported that membres of *Epilohmannia c. cylindrica* feed mainly on fungi (hyphae and spores).

In conclusion, desert ecosystem grazing creates favorable circumstances via animals excrement that accompanied with decomposition process such additives could enhance the microorganisms which in turn has great influence on reproduction potential of mites results in increase of mite juveniles. Al-Assiuty(1981), Abdel-Lateif 2015) indicated that the flourishing of microorganisms may accelerate the mite multiplication.Although the grazed biotope revealed the highest number of mites, however the current reproductive status in grazed biotope being low, this is probably due to the effect of cesticercoid infection (Schuster, 1995 and Trowe, 1997).

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Table1 .Seasonal total nitrogen content percentage and bulk density in grazed and ungreased biotopes

	Grazed Biotope		Ungrazed Biotope	
Season	Total Nitrogen content	Bulk density	Total Nitrogen content	Bulk density
Autumn	0.17%	1.05gm/cm^3	0.12%	1.51gm/cm^3
Winter	0.19%	1.01gm/cm^3	0.13%	1.33gm/cm^3
Spring	0.18%	1.11gm/cm^3	0.11%	1.42gm/cm^3
Summer	0.16%	0.83gm/cm^3	0.9%	1.56gm/cm^3

Table 2:- Monthly air and soil temperature and moisture percentage grazed and ungrazed biotopes.

	Grazed biotope					Ungrazed biotope				
	Temperature					Temperature				
Months	air	3cm	9cm	15cm	Moisture%	Air	3cm	9cm	15cm	Moisture%
Mar	17.6	17.3	18	18.2	15	17.1	18	18.2	18.3	13
Apr	19.3	20.6	21.6	21.8	17	18.6	19.2	19.1	19	12
May	23.3	25.2	25.3	25.9	13	24.6	26	25.7	25.2	11
Jun	25.9	27.2	27.6	27.9	14.5	25.9	26.3	26	25	13.5
Jul	27.2	29.6	29.6	29.4	17.5	28.2	30	29.2	28.4	15
Aug	27.6	28.8	28.5	28.5	18.5	25.4	29.8	30	29.2	11
Sept	26.8	27.6	27.2	27	16.5	27	28.1	28.6	28.1	14
Oct	24.3	24.8	24.2	24.8	17	23.5	25.1	25.3	25	14.5
Nov	17.1	17.3	18	18.4	15.5	18.2	20	21	20.3	15
Dec	15.9	15.1	15.2	15.4	19	15.1	17.1	17.3	17	15
Jan	15.3	13.7	14	14.2	21	15.3	16	16.3	15.9	19
Feb	16.6	15.2	15.7	16	20.5	16.1	17.3	18.1	17.8	20

Table 3. The calculated dominance and constancy of the oribatid species recorded from grazed and ungrazed biotopes

Oribatedspeciees	Grazed biotope		ungrazed biotope	
	Dominance	constancy %	Dominance	constancy %
Epilohmannia c. cylindrical	*19.19	58	*34.63	41.66
Epilohmannia p. aegyptica	2.28	11.67	4.86	9.17
Nothrusbiciliatus	0.67	4.16	0	0
Microzetesalces	0	0	4.86	6.67
Tectocepheusvelatus	1.21	5.8	0	0
Multioppiabayoumii	0	0	1.75	0.05
Multioppiawilsoni	*5.10	22.5	4.09	10.83
Oppianitens	0	0	2.5	0.05
Scheloribatesconfundatus	*7.25	37.5	0	0
Scheloribatesleavigatus	*25.76	83.3	*5.05	16.66
Scheloribatespallidulus	4.42	25	0	0
Passalozetesafricanus	0.27	1.6	0	0
Oppiella nova	2.01	9.2	*36.77	66.66
Zygoribatulacognate	*6.44	33.3	0	0
Zygoribatulaexarata	1.61	5.8	0	0
Xylobatescapcinus	3.89	25	0	0
Xylobateslophotricus	*8.19	41.7	0	0
Plakoribatesmulticaspidus	0	0	0.78	3.33
Galumnaflabellifera	*13.69	59.17	0	0
Lohmanniaturcumanica	0	0	4.28	10.83
Diobelbanortoni	0	0	0.39	1.67

Table 4. The percentage of cysticercoid infections of the oribatid species recorded from grazed and ungrazed biotopes

Spp	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**
Scheloribatesleavigatus	**6**	**61**	**52**	**73**	**12**	**16**	**12**	**0**	**3**	**2**	**0**	**0**
Scheloribatesconfundatus	**3**	**34**	**32**	**46**	**21**	**13**	**-----**	**5**	**----**	**2**	**1**	**0**
Scheloribatespallidulus	**5**	**13**	**20**	**16**	**11**	**9**	**4**	**6**	**1**	**0**	**1**	**1**
Galumnaflabellifera	**2**	**36**	**30**	**42**	**13**	**10**	**3**	**1**	**7**	**2**	**0**	**0**
Zygoribatulacognate	**13**	**23**	**32**	**31**	**15**	**2**	**2**	**3**	**1**	**2**	**0**	**0**
Zygoribatulaexarata	**0**	**2**	**4**	**3**	**2**	**3**	**1**	**0**	**3**	**0**	**2**	**1**
Xylobateslophotricus	**2**	**1**	**12**	**14**	**8**	**1**	**6**	**0**	**1**	**1**	**0**	**0**

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Table 5. Monthly intensity of the vertical movement of the dominant oribatid mites species in grazed and ungrazed biotopes.

Month	Grazed Biotape									UngreazedBiotape				
	Total		Mean Depth Of Dominant Spp.							Total		Mean Depth of dominant Spp.		
	M	S	A	B	C	D	E	F	G	M	S	A	B	F
Mar	6.51	4.08	7.5	14.5	4.91	3	3.86	3.46	13.5	9.8	4.21	11.73	5	9.27
Apr	6.68	4.09	8	14.71	6.72	4.1	3	4.5	9	10.2	3.01	12.5	3	8.18
May	6.86	4.39	6.5	8.25	4.29	3.7	9	8.33	15	12	2.94	15	12	9.67
Jun	12.03	3.42	14.43	12.6	9.43	11.5	---	9	12	12.16	3.59	12.6	---	11.4
Jul	12.19	3.66	14.25	---	11.57	9.9	15	12	15	13.86	3.01	15	11	15
Aug	12.95	3.36	15	---	11.4	12	---	10.5	15	13.67	3.71	15	13.5	15
Sept	9.78	5.13	12.75	12.43	10.95	7	4.9	11.5	15	13.11	4.09	13.29	12	13.62
Oct	11.16	4.76	11	15	14.4	7	3	5.8	9	8.19	3.1	9.3	3	8
Nov	6.93	4.77	9	10.2	6	6.6	9	4.71	5	8	4.22	8.25	---	4.76
Dec	7.67	4.36	7.65	7.5	6.46	3	15	3.71	9	7.93	3.96	8.14	10.5	7
Jan	6.91	4.02	6.53	11.7	3.2	3.86	3.75	5.14	6	8.45	3.25	8.17	9	7.57
Feb	7.04	4.33	8.5	10.5	4.1	4.2	6.2	4.6	6	8.07	3.55	8.65	9	6.6

A. ***Scheloribatesleavigatus*** **B.** ***Epilohmannia c. cylindrica***
C.*Galumnaflabellifera* **D.** ***Xylobateslophotricus***
E.*Scheloribatesconfundatus* **F.** ***Zygoribatula cognate*** **G.** ***Multioppiawilsoni***

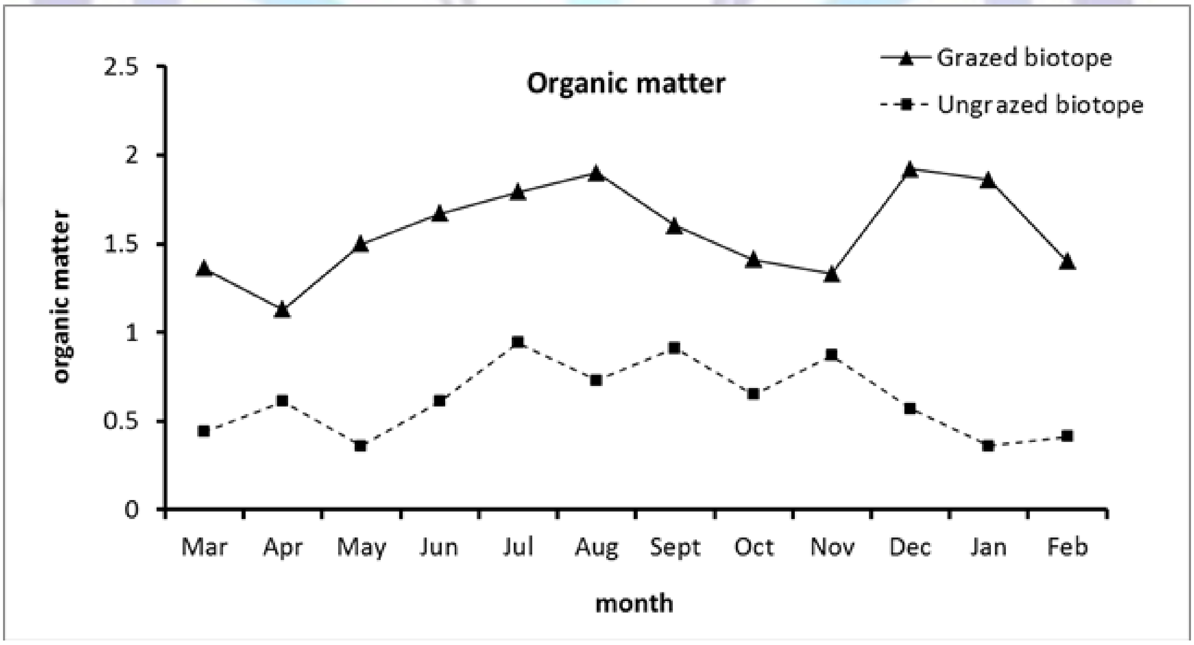

Figure 1. Monthly fluctuations of the organic matter content in grazed and ungrazed biotopes.

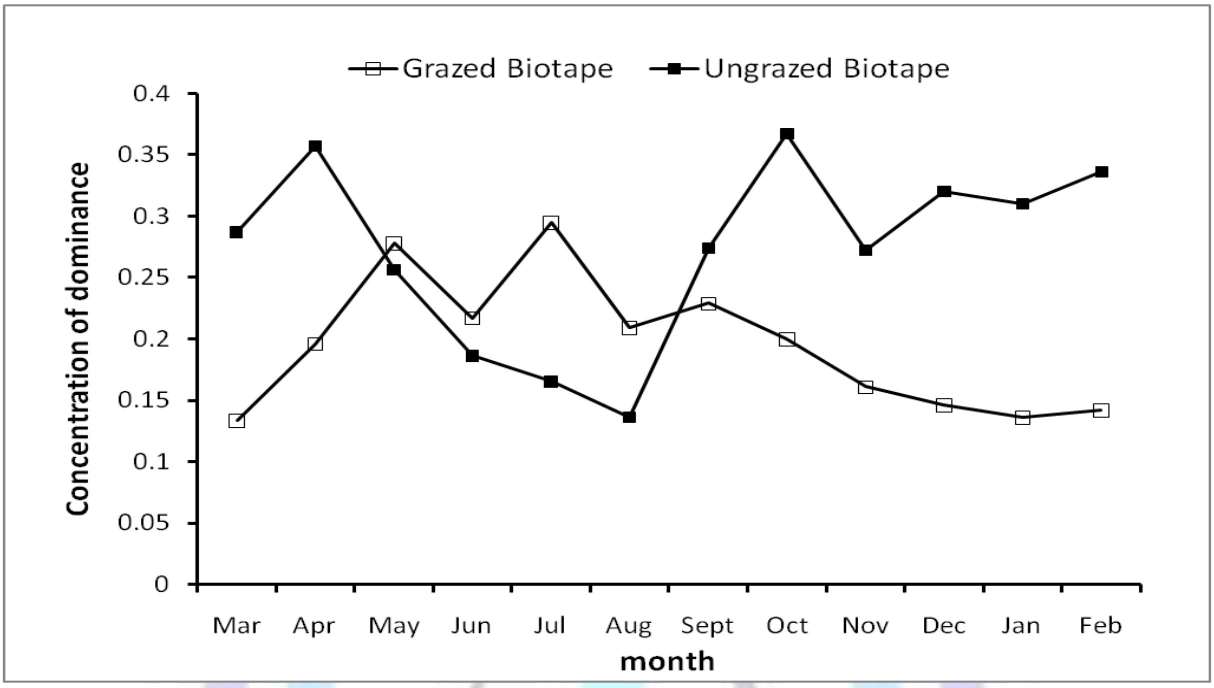

Figure 2. Monthly fluctuations in concentration of dominance grazed and ungrazed biotopes.

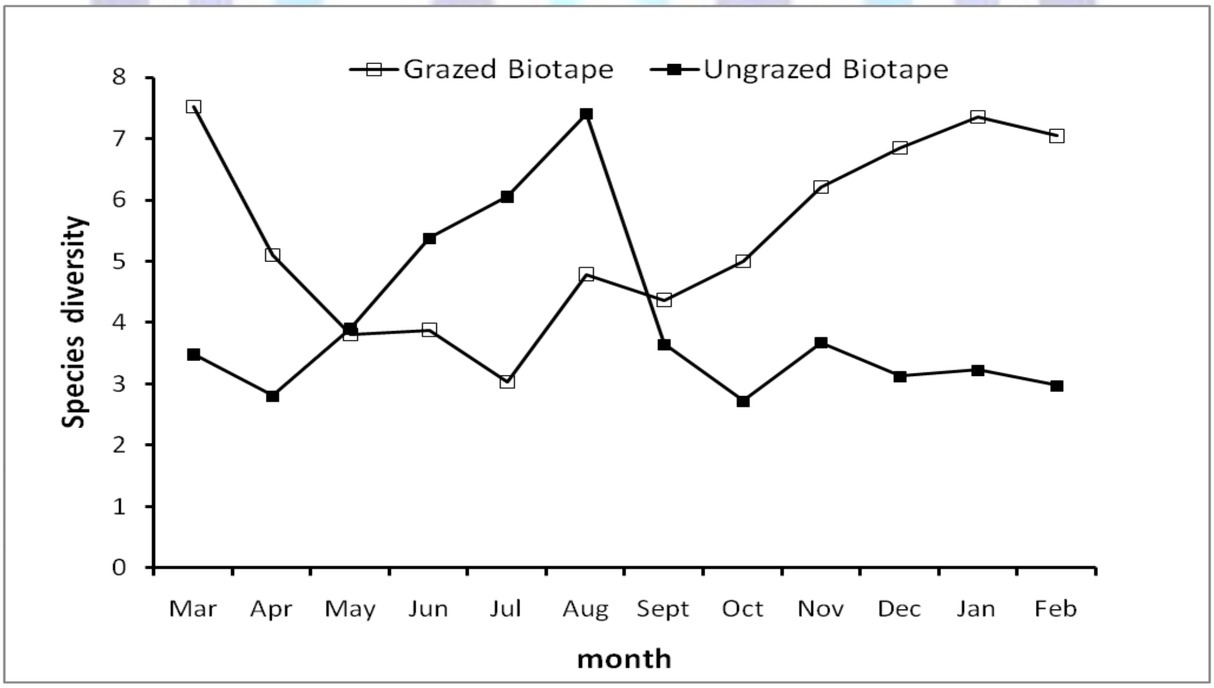

Figure 3. Monthly fluctuations in species diversity grazed and ungrazed biotopes.

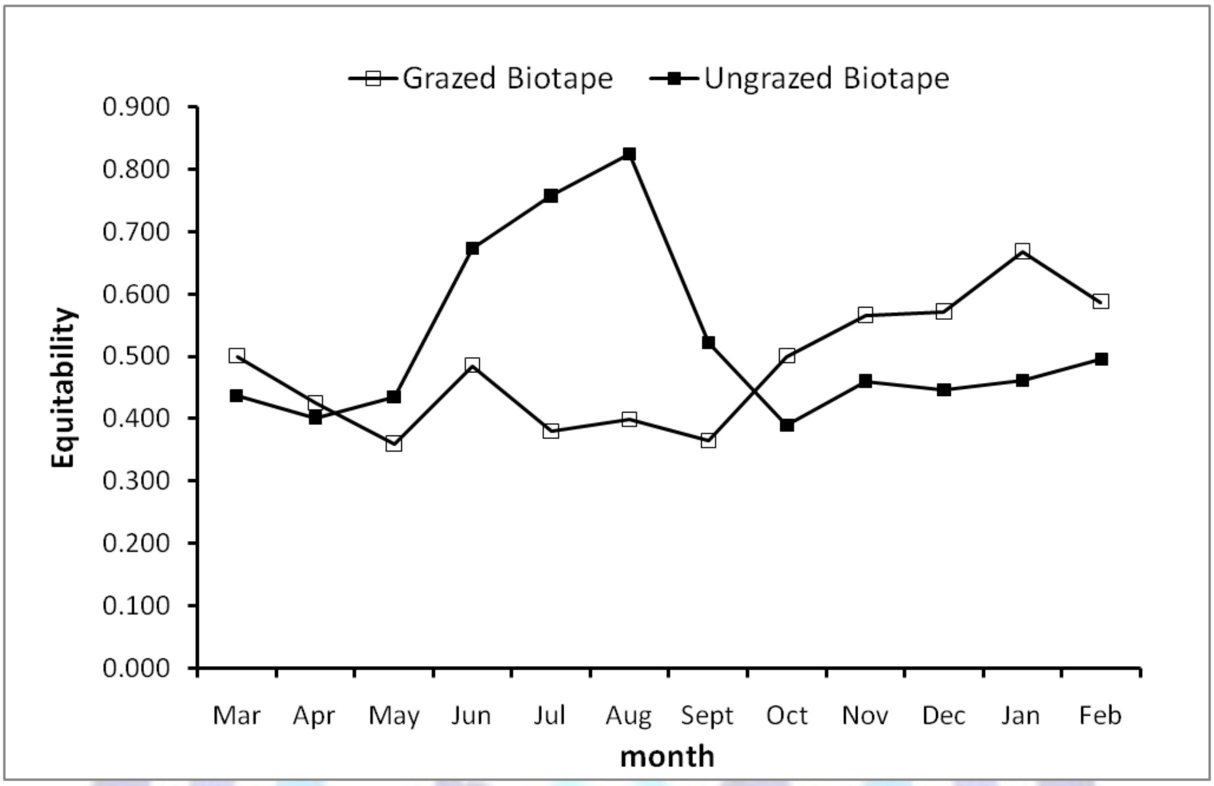

Figure 4. Monthly fluctuations in equitability grazed and ungrazed biotopes.

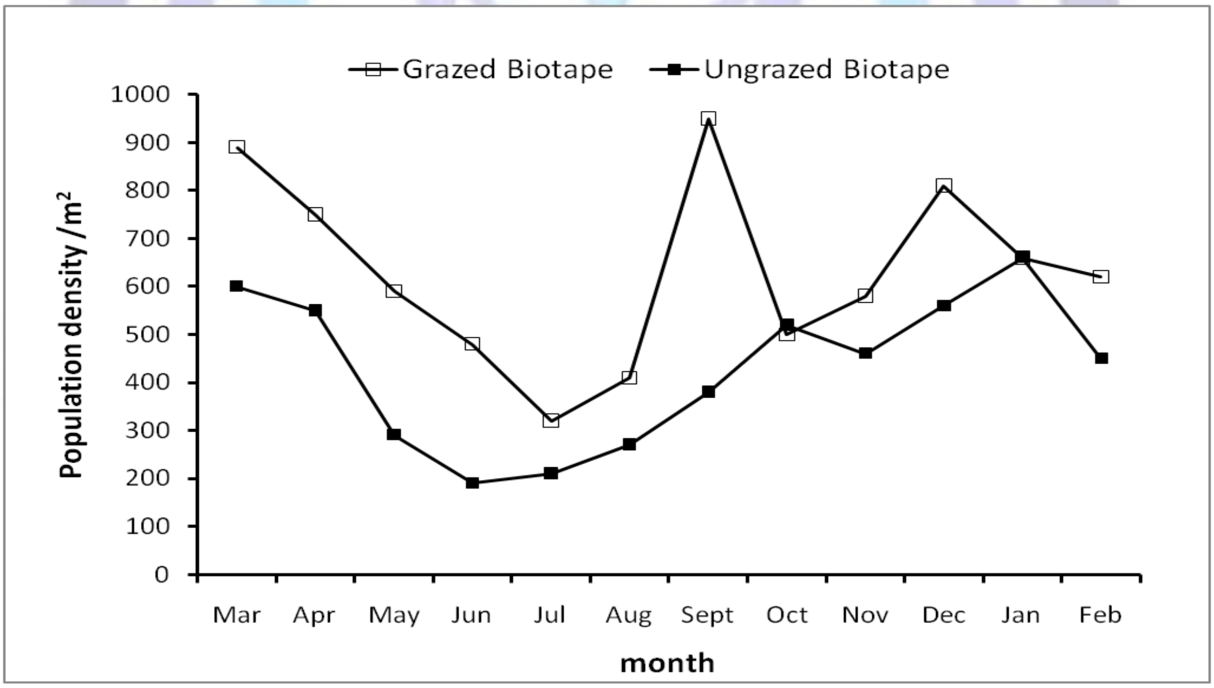

Figure 5. Monthly fluctuations in of total population densities grazed and ungrazed biotopes.

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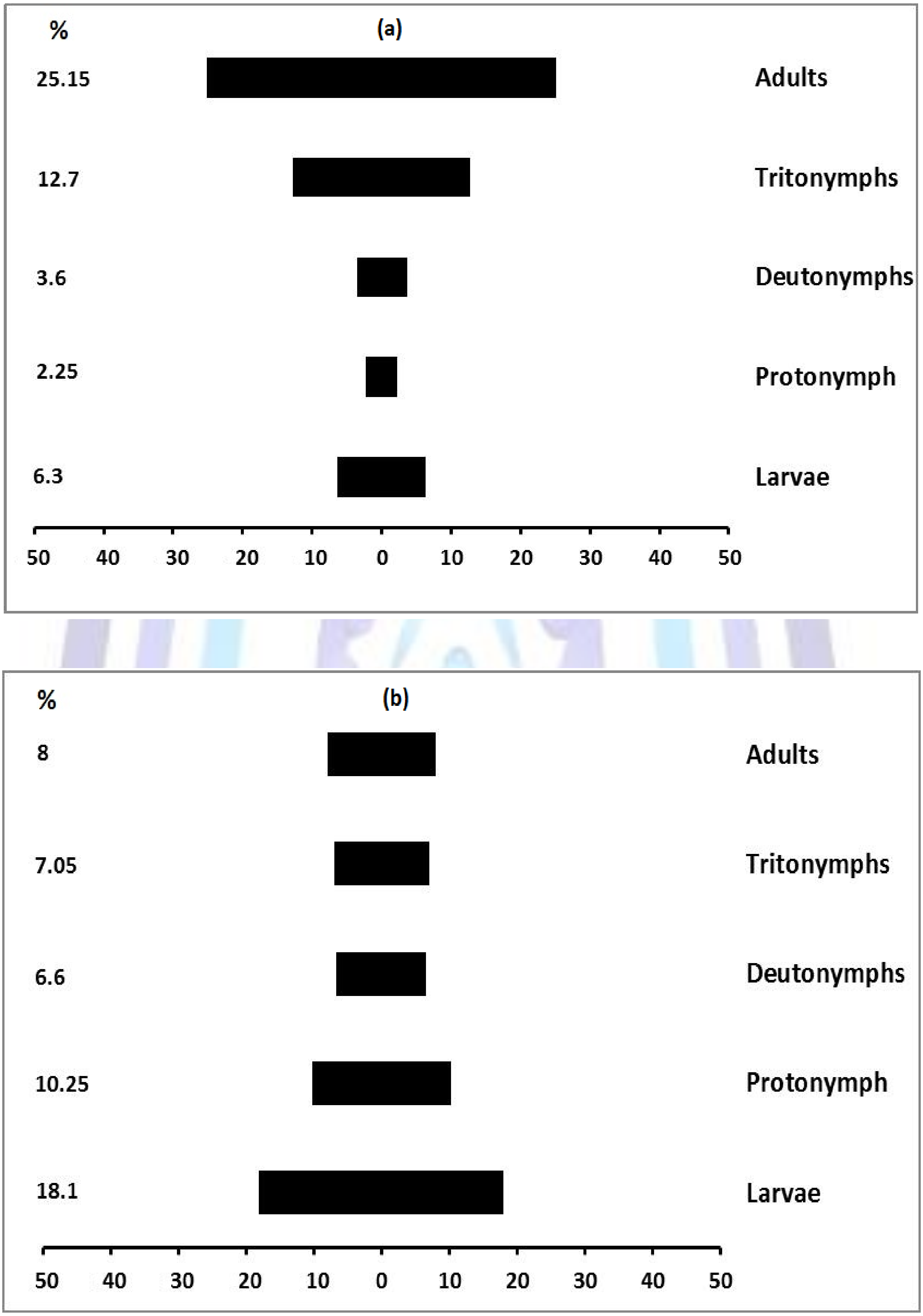

Figure 6. Population age distribution of five different age classes of mites in (a) grazed and (b) ungrazed biotopes.