## EFFECT OF TREE IDENTITY, TEMPORAL VARIATION AND EDAPHIC PARAMETERS ON THE STRUCTURE OF THE EDAPHIC COMMUNITY OF ORIBATID MITES IN AN EVERGREEN TROPICAL FOREST OF MEXICO

 $\label{eq:Villagomez, F.} Villagomez, F.^{1,2*}-Palacios-Vargas, J. G.^1-Castaño-Meneses, G.^3-Castellanos-Vargas, I.^4$ 

<sup>1</sup>Laboratorio de Ecología y Sistemática de Microartrópodos, Facultad de Ciencias, Universidad Nacional Autónoma de México, 04510 Cd. Mx., México

<sup>2</sup>Posgrado en Ciencias Biológicas, Unidad de Posgrado, Edificio D. Universidad Nacional Autónoma de México, 04510 Cd. Mx., México

<sup>3</sup>Unidad Multidisciplinaria de Docencia e Investigación, Facultad de Ciencias, Universidad Nacional Autónoma de México, Campus UNAM 3001, Juriquilla, 76230 Querétaro, México

<sup>4</sup>Grupo de Interacciones y Procesos Ecológicos, Departamento de Ecología y Recursos Naturales, Facultad de Ciencias, Universidad Nacional Autónoma de México, 04510 Cd. Mx., México

> \**Corresponding author e-mail: lfvilagomez@gmail.com; phone:* +52-55-5622-4902

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**Abstract.** This paper analyzes the community structure of edaphic oribatid mites from the tropical forest at Los Tuxtlas, Veracruz, showing its monthly variation during only one year, considering two contrasting tree species and their relation with abiotic edaphic parameters. Randomly, five *Astrocaryum mexicanum* and *Guarea glabra* plants were chosen and near the stem of each one, a sample of soil was taken and processed in the same biological station with Berlese-Tullgren funnels. The most abundant families were Scheloribatidae, Oppiidae, Xylobatidae, Arceremaeidae, and Galumnidae. The Kruskall-Wallis test showed that structure of oribatid mite community is not significative related to tree identity, which they are associated. Pearson's multiple correlation showed that the edaphic temperature is one of the most important abiotic factors in the structuring of oribatid mites communities. The abiotic variables explained 58% of oribatid community variance in its first two axes, with temporality and CO<sub>2</sub> being the factors with most influence over the community. It is concluded that tree identity is not a factor that affects the structuring of oribatid mite communities in this tropical forest, while temporality, soil temperature and CO<sub>2</sub> are the factors that most influence its establishment, this last factor as an indirect indicator of system productivity.

Keywords: arboreal identity, community diversity, temporality, Astrocaryum mexicanum, Guarea glabra

### Introduction

From several decades edaphic communities have been observed to have a high value of biotic diversity, it is even estimated that our current knowledge covers less than 10% of the total number of species worldwide, due in part to the lack of studies, low efficiency in extraction methods and methodological issues (André et al., 2002). Together with the canopy, the need to study edaphic communities to understand the functioning of ecosystems has been evidenced, considering the soil as one of the last biotic frontiers (André et al., 1994). Anderson (1975) mentions that the mechanisms by which such diverse communities exist are poorly understood, and he named it as the

"enigma of animal diversity in the soil". Since then, multiple factors associated with this phenomenon have been proposed, although most of them are focused on the litter diversity, reporting the environmental heterogeneity, content of organic matter, temperature, soil pH, humidity and altitude as some of the determining factors of the communities (Perdue and Crossley, 1989; Urhan et al., 2006; Mumladze et al., 2015). Nielsen et al. (2010) hypothesized that small-scale environmental heterogeneity in respect to organic and mineral soil can be responsible of this high species richness, and recently Bernier (2018) emphasizes the importance of the type of humus for the establishment of the edaphic fauna, not only as a transition point between the soil and litter, but also as a kind of habitat with particular characteristics.

Forest soils are ecosystems characterized by being extremely fertile, in addition to having a great biodiversity in their first 20 cm, which contributes in the cycle of nutrients and decompositions of organic matter (Gessner et al., 2010). In the edaphic communities of tropical forests, oribatid mites are numerically dominant organisms, and species richness of their biotic community is generally around 70 species (Kaneko et al., 2005; Mumladze et al., 2015). Wunderle (1992) reports 82 species of oribatids with an average density of 61,500 individuals per m<sup>2</sup> for a low rain forest in Peru, while Ferreira et al. (2012) recorded 143 species of oribatids and up to 460 morphospecies for the Brazilian Amazon. In Mexico, there have been communities in tropical forests up to 120 species for the state of Quintana Roo (Vázquez, 2006).

It has been reported that abundance of oribatid mites show spatial and temporal (seasonal) variations, which reflects different dynamics of the microhabitat, although the taxonomic composition often does not reflect this pattern (Irmler, 2006; Wehner et al., 2018). Temporal variations in abundance are usually related to parameters such as temperature, humidity and even the availability of food, although sometimes these effects tend to influence particular species but frequently not all the community in general (Gergócs et al., 2011). Despite registering patterns of seasonal variation in his abundances, little is known about the role of the leaf litter and identity of the plants in relation to the stability of the community of mites that inhabit the soil near them.

Although the incorporation of leaf litter into the soil of ecosystems contribute with elements such as nitrogen, phosphorous and carbon differentially in relation to the plant species and senescent phase (Fonte and Schowalter, 2004), the diversity of oribatids on the litter is not much influenced by plant richness, nor by the accumulation of organic matter from different species (Kaneko et al., 2005), even with plants with allelochemical attributes that directly influence the chemical composition of the soil by the production of metabolites and other substances, are not capable of altering the structure of his communities (Osler and Beattie, 2001). However, in other papers this group has responded positively in relation to the increase in plant richness and diversity of litter (Kaneko and Salamanca, 1999; Hansen, 2000). Because most of the investigations are focused on analyzing the structure of the community in upper litter of the forest soils, it is not known if the community has this same behaviour belowground.

The tropical rain forest of Los Tuxtlas in the state of Veracruz is one of the last relicts of high tropical evergreen forest in Mexico. The Sierra of Los Tuxtlas is a mountain formation of volcanic origin, located in the coastal plain of the Gulf of Mexico, within this region is the Los Tuxtlas Tropical Field Station (hereafter referred to as LTS), this station was founded in 1968 and is operated by the Universidad Nacional Autonóma de México, actually has an area of 640 ha and its elevation range goes from 150 to 720 m asl (Dirzo et al., 1997).

The palm *Astrocaryum mexicanum* Leibm. is the most abundant plant species of LTS, can register from 300 to 1,230 individuals per hectare and constitutes 20 to 61% of the total density of plants (Piñero et al., 1977), it has a longevity of 140 years and have heights of 1.5 to 6 meters (Piñero et al., 1984). This plant is favoured by disturbance, since its population grew from 1975 to 2013 with an average of 2.9% per year due to habitat alteration, edge effect and anthropogenic impact (Martínez-Ramos et al., 2016).

This palm is characterized by a monocaule stem of 10 cm thick and spiny leaves up to one and a half meters that have a development of 1.6 to 5 leaves per year in relation to the degree of light which they are exposed (Núñez-Castillo and Álvarez-Sánchez, 2003). Due to architecture, form of growth and the large number of thorns up to 6 cm that present in the stem, fruit and leaves, this plant has the ability to store a large amount of organic matter in its petioles, mainly of leaf litter from other trees, which gives an extra contribution of nitrogen and phosphorous by means of the decomposition on the plant that later reaches the soil by cauline flow (Raich, 1983; Álvarez-Sánchez et al., 2016).

*Guarea glabra* Vahl., also abounds in LTS (Álvarez-Sánchez and Guevara, 1999). It reaches heights of 25 m and has up to 30 cm in diameter (Coronado, 2006). It can persist for periods close to 100 years (Ibarra-Manríquez et al., 1997), has a strong trunk that begins to branch from near three meters and all the year constantly generates leaves, the fruits typically occur from May to July (Wenny, 1999) in reproductive season, its fruits cover small regions of soil, being a strong contribution of nutrients and organic matter to it.

Both plant species are part of different functional groups: *A. mexicanum* has a lower contribution of organic matter to the litter and soil and presents a slow decomposition rate (León, 2003) compared to *G. glabra* which is constantly generating and releasing leaves to the soil, also the genus *Guarea* present a quick green-leaf decomposition rate (Fonte and Schowalter, 2004). They have a different architecture and the first one enriches the soil by means of the continuous decomposition of organic matter that it captures in its leaves and petioles, incorporating nutrients into the soil by caulinar flow (Álvarez-Sánchez et al., 2016), while the contribution of nutrients and organic matter by *G. glabra* comes from the decomposition of leaves and temporarily from its fruits, incorporating magnesium, sodium and potassium mainly in the superior edaphic profiles (Barrantes and Ortiz, 2011).

The objective of this work is to analyze the effect of tree identity of two species of taxonomic and morphologically contrasting plants, monthly variation and soil abiotic parameters (pH, organic matter, organic carbon, CO<sub>2</sub>, porosity and soil moisture) on the diversity and structure of the belowground oribatid mite community in this Mexican tropical forest.

Our first hypothesis is that tree species will have a significant effect on the structure of the belowground oribatid community, we infer that in the soil associated with G. glabra the diversity, richness and abundance of oribatids will be greater due to the abundant and constant contribution of organic matter by this plant to the soil. A. mexicanum releases few leaves and most of the nutrients it contributes to the soil come from captured organic matter that decomposes on it, so that the amount of plant material and decomposition rate is lower, also we assume a different species composition in oribatid communities of both plants soils, with more species inhabiting soil related with G. glabra due to a bigger thickness of soil organic horizon in comparison of A. mexicanum. Our second hypothesis is that the community will show a significant variation in its richness, abundance, diversity and composition in relation to temporality

(months), and soil abiotic parameters, being the families Galumnidae, Scheloribatidae, Haplozetidae, Oppidae, Phthiracaridae and Carabodidae more abundant as reported in literature for others tropical rainforest (Franklin et al., 2006; Caruso et al., 2019).

## Materials and methods

### Study area and description

LTS geographically is located in state of Veracruz, Mexico, between  $18^{\circ}34'$  to  $18^{\circ}36'$ N and  $95^{\circ}04'$  to  $95^{\circ}09'$ W (see *Fig. 1*). This station is mostly covered by evergreen tropical rain forest favoured by a warm climate with rainfall throughout the year, rainfall in the driest month is above 60 mm and are accentuated in the months of June to February marking a season of "rains" and one of "dry" in March to May, being September the month with greater precipitation. In addition, presents a scarce thermal variation, keeping mostly between 24 and 26 °C (Soto and Gama, 1997).



Figure 1. Location of Los Tuxtlas Tropical Field Station (LTS) in Veracruz, Mexico, and position of sampling sites within LTS (modified from Flores et al., 2014)

## Sampling method

To analyze the effect of the leaf litter on the structure of belowground oribatid mite community, at random in a non-traveled area outside the walking paths Vigia 4 and 5 within the LTS (*Fig. 1*) five plants of *G. glabra* and another five of *A. mexicanum* were chosen in a paired design, the litter near the trunk was removed manually and immediately five samples of soil were taken associated with different arboreal individuals of *A. mexicanum* and five more with *G. glabra* with soil nucleators (11 cm wide and 5 cm deep) (see *Fig. 2*). The material was collected monthly from March 2016 to February 2017 and processed *in situ* the same day of collection in Berlese-Tullgren funnels during six days (three days without light and three days with 25-watt bulbs).

The record of environmental parameters of temperature, relative humidity and  $CO_2$  was made by using a thermo-hygrometer IAQ-Calc<sup>TM</sup>, model 8760 at ground level. Additionally, 100 g of soil were taken to determine the gravimetric humidity of the soil, porosity, pH, percentage of carbon (%C) and organic matter (%O.M.).

### Laboratory techniques

The soil pH was measured with 10 g of sifted soil diluted in distillate  $H_2O$  with a pH meter. %O.M. was obtained by Walkey-Black method (Walkey, 1947) with 0.2 g of sifted soil, percentage of carbon (%C) was calculated as in *Equation 1*:

$$%C = (\%O.M.)(0.58)$$
 (Eq.1)

For obtaining soil porosity (Jackson, 1976; Van Reeuwijk, 2002) we first measured apparent density (*Ad*) of soil by weighting a test tube of 10 ml, then added soil until 10 ml, using a funnel and hit above-down from 20 cm ten times softly, posteriorly added again soil to refill 10 ml and weight again the test tube, by resting the test tube weight and dividing it in test tube volume we obtain de apparent density ( $g/cm^3$ ), the density of solid particles of soil was obtained by pycnometer method (Blake and Hartge, 1986). First the dry pycnometer was weighted (*S*), then 5 g of soil was added and the pycnometer is filled with water (s + a), finally the soil is removed and the pycnometer is filled with water (S + A). We calculate the of soil particles density (Sd) with Equation 2.

$$Sd = \frac{S}{S+A} - s + a \tag{Eq.2}$$

The total porosity (*Ptotal*) was obtained using the apparent density and density of soil particles with *Equation 3*.

$$Ptotal = \frac{(1-Ad)(100)}{Sd}$$
(Eq.3)

The mites were separated and quantified manually under the stereoscopic microscope (Zeiss<sup>TM</sup>, Stemi 2000), later they were mounted in semi-permanent preparations in Hoyer's solution. Identifications were made at the finest taxonomic level possible by dichotomous keys (Balogh and Balogh, 1992) and specialized literature for each family, those with identification problems were assigned to morphospecies, the specimens are deposited in the collection of Collembola and edaphic mites of the Laboratory of Ecology and Systematics of Microarthropods (LESM), Faculty of Sciences, UNAM, Mexico.



Figure 2. Schematic diagram of experimental setup. a Soil samples taken around <u>Guarea</u> <u>glabra</u>. b Soil samples taken around <u>Astrocaryum mexicanum</u>. Months underlined correspond to 2017 year, all others from 2016

### Numerical and statistical analysis of the community

To observe the fit of data and type of analysis to be performed, its normality was tested with Kolmogorov-Smirnov test in software R (R Core Team, 2016), and homoscedasticity with Statistica v.8.0. (Statsoft Inc, 2007). For each sample of tree species was obtained the abundance and oribatid species richness (S) by direct count, also, Pielou's equitativity (J'), Simpson's dominance (D) and Shannon diversity index (H') were calculated in PAST 3.22 software (Hammer et al., 2001) with Equations 4, 5 and 6, respectively.

$$J' = \frac{H}{\ln(S)}$$
(Eq.4)

$$D = \left(\frac{n_i}{n}\right)^2 \tag{Eq.5}$$

$$H' = -\sum \frac{n_i}{n} \ln \frac{n_i}{n} \tag{Eq.6}$$

The effective species number  $({}^{1}D)$  was obtained through Shannon exponential with *Equation* 7 (e<sup>H</sup>; Jost, 2006).

$${}^{1}D = \exp(H') \tag{Eq.7}$$

To determine the effect of the identity of the plant species on the abundance, density, species richness, dominance and equity of the community of oribatid mites a nonparametric Kruskall-Wallis test was carried out between each plant community data in R software. Also, a t test with Shannon diversity index (H') were performed in PAST 3.22 software for analyze possible variations in this community attribute between plants.

The relationship and significance between the community structure and soil abiotic factors was tested by a multiple correlation analysis of Pearson in software R with  $\alpha = 0.05$ , including factors as abundance, density of individuals, richness (*S*), diversity (*H'*), effective species number (<sup>1</sup>D), equity (*J'*), dominance (*D*) and soil parameters like CO<sub>2</sub>, pH, temperature, moisture, %O.M., %C and porosity. We performed a Canonical correspondence Analysis (CCA) using the CCorA function in vegan package (Oksanen et al., 2016) with Software R (R Core Team, 2016) to detect interactions between the community of oribatid mites and abiotic parameters, the envfit function ("Fits an Environmental Vector or Factor Onto An Ordination) was used with 999 permutations, to get the p-value or correlation of each variable with overall oribatid community, samples with total absence of specimens was removed from the analysis.

#### Results

A total of 2577 Oribatid mites with a mean monthly density of 289.49 ind/m<sup>2</sup>, belonging to 41 families and 72 species (see *Table 1* and *Appendix 1*). Most abundant families were Scheloribatidae (320 specimens), Oppiidae (288), Oripodidae (285), Protoribatidae (266), Arceremaeidae (222), Galumnidae (186) and Haplozetidae (148). Total abundance of oribatid present in soil of *G. glabra* (1,321) was slightly higher than that recorded in *A. mexicanum* (1,256). Most abundant species throughout the study

were Scheloribates ca. grandiporosus, Tecteremaeus cornutus, Brasilobates sp. nov. and Benoibates sp. nov. with 9.5%, 8.6%, 8.4% and 8% respectively from the total of individuals.

Specific composition of oribatids between soils from trees was shared in 78%, with 56 species in common between both communities, while seven were exclusively in *G. glabra* soils and nine in soils of *A. mexicanum*, although most of these records were made through the presence of a single specimen. *Acrotritia ardua* (March, April, May and August) and *Rostrozetes cubanus* (October, November and December) were the only species that present records in at least three months in soil of *G. glabra* and *A. mexicanum* respectively. Most abundant species related to *G. glabra* were *Benoibates* sp. nov. and *Scheloribates* ca. *grandiporosus*, while in *A. mexicanum* they were *Tecteremaeus cornutus* and *Brasilobates* sp. nov.

No homoscedasticity was found in the samples corresponding to both plant species, the Kolmogorov-Smirnof test showed that oribatids abundance was not a normal distribution (D = 0.166, p = 0.0026), making it necessary to use nonparametric methods for its analysis.

No significant differences were found between the community of oribatids associated to *G. glabra* and *A. mexicanum* through the analysis of Kruskall-Wallis in relation to abundance  $(X^2 = 0.203; p = 0.651)$ , density  $(X^2 = 0.204; p = 0.651)$ , richness (*S*)  $(X^2 = 0.117; p = 0.733)$ , dominance (*D*')  $(X^2 = 0.008; p = 0.927)$  and equity (*J*')  $(X^2 = 1.8162; p = 0.178)$ . The t-test for diversity between the community associated with these two plants using the Shannon entropy index (*H*') showed no significant differences  $(t_{22} = 1.7691, p = 0.077)$ . Due to the lack of significant effects of tree species to the edaphic community of oribatids, their abundance from both plants was grouped for the analysis of temporal variation and its relationship with abiotic soil factors.

The highest abundance was recorded in March 2016 (Table 1), while the lowest was presented in February 2017; there is a second period of population increase in July and August 2016 with 372 and 305 specimens respectively. In March 2016, there were four species with the greatest abundance: Brasilobates sp. nov., Scheloribates ca. grandiporosus, Rostrozetes foveolatus and Galumnidae gen. nov. In July 2016 three species that showed high abundance in March again increase their population numbers; however, five different species increased their abundance in this season (Tecteremaeus cornutus, Benoibates sp. nov., Multioppia sp., Mesoplophora longisetosa, and Scheloribates praeincisus), which shows a temporal differentiation in relation to the specific composition of the oribatid community. The variation of the abundance of the oribatid species was very evident in some months (see Appendix 1), with families which live throughout the year (Arceremaeidae, Protoribatidae, Galumnidae, Epactozetidae, Oppiidae), Neoliodidae, others that are only temporary (Epilohmannidae, Mesoplophoridae, Malaconothridae) and some circumstantial like Cymbaeremaeidae, which normally can be found inhabiting in the trunk or canopy of trees.

The highest richness (S) was presented in August (*Table 1*), followed by July and June, the lowest richness was recorded in February. The average diversity of all months according to the Shannon index was high (H' = 2.96), the greatest true diversity ( ${}^{1}D$ ) was reported in November and July, while the lowest was in February and May, with an average of 20.24 effective species number per month. The highest dominance (D) was registered in February due to the low number of specimens and the big abundance of a member of *Truncozetes sturmi* (Epactozetidae), and in May mainly due to the high abundance of three species of families Oppiidae (*Multioppia* sp.), Scheloribatidae (*Scheloribates praeincisus*) and Protoribatidae (*Brasilobates* sp. nov.). The values of the equity index (J') showed quite homogeneous communities, because they were always above J' = 0.75, the month with the greatest equity were January and November, while the least equitable was May. Statistically significant differences between each collecting month and numerical attributes of oribatid mites community can be found in *Appendix 2*.

Year			2017									
Month	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Ν	495	297	185	243	372	305	197	116	166	113	49	39
$Ind/m^2$	1061	344.1	214.3	281.57	431	353.4	228.3	134.4	192.3	131	56.8	45.2
S	35	36	32	41	46	50	39	36	39	28	24	13
H'	3.06	2.85	2.70	3.16	3.26	3.18	2.87	3.20	3.32	2.83	2.92	2.22
$^{I}D$	21.52	17.34	14.99	23.66	26.23	24.07	17.63	24.68	27.91	17.03	18.54	9.29
D'	0.06	0.09	0.11	0.05	0.05	0.07	0.09	0.06	0.04	0.08	0.07	0.14
J'	0.86	0.79	0.78	0.85	0.85	0.81	0.78	0.89	0.90	0.85	0.92	0.86

Table 1. Monthly numerical attributes of oribatid mites community in Los Tuxtlas, Veracruz

Maximum and minimum values of each parameter in bold

Abundance (N) = total number of individuals; density  $(Ind/m^2)$  = monthly mean of individuals/m<sup>2</sup>; Species richness (S) = Number of species; Shannon diversity index (H') = Shannon entropy index using ln; true diversity (<sup>1</sup>D) = Effective number of species with rank 1 (<sup>q</sup> = 1); D' = Dominance index; J' = Pielou's equity (evenness)

Kruskall-Wallis analysis showed a significant relation between collecting month with abundance and density ( $X^2 = 56.53$ ; p < 0.001), Richness (*S*) ( $X^2 = 51.99$ ; p < 0.001), diversity (*H'*) and effective species number ( ${}^{1}D$ ) ( $X^2 = 48$ ; p < 0.001) and marginally significative with Dominance (*D'*) ( $X^2 = 19.52$ ; p = 0.052), only the relation with equity (*J'*) was not significative ( $X^2 = 14.653$ ; p = 0.199). With which the monthly seasonality showed to be a key factor in the structuring of the community of oribatids in this jungle (*Appendix 2*).

For the Pearson's correlations between the edaphic parameters and the structural attributes of the community, only the relation between soil temperature with the density (r = 0.641, p = 0.0009), richness (r = 0.621, p = 0.0022), dominance (r = 0.524; p = 0.0420) and true diversity (r = 0.604, p = 0.004) were significative and positive, so the soil temperature is one of the factors that most influence the communities structure of these mites in the jungle; while porosity, percentage of organic matter, pH, humidity and organic carbon did not have a significant interaction with the community of oribatids (*Table 2*).

The canonical correspondence analysis for the soil abiotic variables (*Fig. 3*) explains in its first two axes 58% of the variance in the community of oribatids (axis 1, 36%, axis 2, 22%). The monthly temporality shows a high negative correlation with axis 1 (r = -0.9222); similarly, the percentage of soil CO<sub>2</sub> shows a high negative correlation with axis 2 (r = -0.7211); CO<sub>2</sub> is indicative of the high primary productivity of the system and therefore of the high amount of food available for the oribatids (Herrera et al., 2001). The variables that correlate significantly with the ordination were temporality, soil temperature, CO<sub>2</sub>, soil relative humidity, percentage of organic matter and organic carbon (*Table 3*). The species most related to axis 1 are *Licneremaeus discoidalis* (Ld), *Kaliptrazetes desaussurei* (Kd) and *Berlesezetes peruensis* (Bp), these last two species are also related positively to axis 2, *Klapperiches* sp. nov., *Protoribates capucinus* and *Epilohmannia pallida* are the species more related negatively to this axis (*Table 4*).

	Ν	ind/m2	S	H′	<sup>1</sup> <b>D</b>	Month	CO <sub>2</sub>	pН	Por	sT	%C.O.	%M.O.	%RH
Ν		<.0001	<.0001	<.0001	<.0001	<.0001	ns	ns	ns	ns	ns	ns	ns
ind/m2	0.836		<.0001	<.0001	<.0001	<.0001	ns	ns	ns	0.0009	ns	ns	ns
S	0.975	0.729		<.0001	<.0001	<.0001	ns	ns	ns	0.002	ns	ns	ns
Η′	0.935	0.735	0.97		<.0001	0.0003	ns	ns	ns	0.0035	ns	ns	ns
$^{1}\mathbf{D}$	0.878	0.835	0.877	0.929		0.0008	ns	ns	ns	0.0004	ns	ns	ns
Month	-0.741	-0.69	-0.693	-0.667	-0.646		ns	ns	ns	<.0001	ns	ns	ns
$CO_2$	-0.021	-0.144	0.006	0.01	-0.092	-0.009		0.042	ns	ns	ns	ns	ns
pН	-0.1	0.05	-0.099	-0.046	0.029	0.314	-0.534		ns	ns	ns	ns	ns
Por	-0.141	-0.542	-0.159	-0.173	-0.154	-0.07	-0.152	-0.08		ns	ns	ns	ns
sT	0.681	0.641	0.621	0.608	0.604	-0.883	0.231	-0.375	-0.101		ns	ns	ns
%O.C.	-0.11	-0.111	-0.116	-0.086	-0.082	0.31	0.1	0.029	-0.263	-0.278		ns	ns
%O.M.	-0.11	-0.111	-0.116	-0.086	-0.082	0.31	0.1	0.029	-0.263	-0.278	1		<.0001
%RH	-0.138	-0.147	-0.101	-0.092	-0.105	0.035	0.114	-0.288	0.199	-0.145	-0.063	0.063;	

**Table 2.** Pearson correlation coefficients and p-values of structural attribute of oribatid mites community and soil abiotic factors

Scores below diagonal, p-value above diagonal

Abundance (N) = total number of individuals; density  $(Ind/m^2)$  = monthly mean of individuals/m<sup>2</sup>; Species richness (S) = Number of species; Shannon diversity index (H') = Shannon entropy index using ln; true diversity (<sup>1</sup>D) = Effective number of species with rank 1 (<sup>q</sup> = 1); D' = Dominance index; J' = Pielou's equity index (evenness)

Por = soil porosity; sT = soil temperature; %O.C. = percentage of organic Carbon; %O.M. = percentage of organic matter; %RH = percentage of soil relative humidity; ns = non significant

	CCA1	CCA2	r <sup>2</sup>	p-value
Month	-0.995	-0.091	0.75	0.001***
sT	-0.992	-0.125	0.404	0.002**
$CO_2$	0.473	-0.880	0.516	0.001***
% RH	0.719	-0.694	0.353	0.006**
% O.M.	0.687	0.726	0.249	0.050*
% O.C.	0.687	0.726	0.249	0.050*
gH	-0.653	-0.756	0.104	0.318
pН	-0.876	0.482	0.160	0.137
rD	-0.393	-0.919	0.199	0.100
aD	-0.368	0.929	0.060	0.493
Por	-0.292	-0.956	0.153	0.132
Tree	0.218	0.975	0.014	0.865

**Table 3.** Envfit, CCA squared correlation coefficients  $(r^2)$  and significance levels of the oribatid mites species abundance with respect to abiotic soil parameters

\*Significance level

%O.C. = percentage of organic carbon; %O.M. = percentage of organic matter; sT = soil temperature; gH = gravimetric humidity; rD = real density of soil; Por = soil porosity; aD = apparent density; %RH = relative humidity of soil

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Figure 3. Canonical correspondence analysis between oribatid species abundance and edaphic abiotic parameters. Factors abbreviations: %O.C. = percentage of organic carbon;
%O.M. = percentage of organic matter; sT = soil temperature; gH = gravimetric humidity;
rD = real density of soil; Por = soil porosity; aD = apparent density; %RH = relative humidity of soil. Species abbreviations: L.d. = Licneremaeus discoidalis; K.nov. = Klapperiches sp. nov.; K.d. = Kalyptrazetes desaussurei; B.p. = Berlesezetes peruensis; P.c. = Protoribates capucinus; E.p. = Epilohmannia pallida

Table 4. CCA species scores of the species more related with	th Axis 1	and 2
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Family	Genus and species	CCA axis 1	CCA axis 2
Licneremaeidae	Licneremaeus discoidalis	1.640062	-0.420947
Microzetidae	Kalyptrazetes desaussurei	1.474698	1.849525
Microzetidae	Berlezesetes peruensis	1.468658	1.846099
Carabodidae	Klapericches sp. nov.	0.639038	-1.902672
Protoribatidae	Protoribates capucinus	0.684869	-1.551144
Epilohmannidae	Epilohmannia pallida	0.9484	-1.513977

Bold number denotes to which axis are more related

#### Discussion

There is a large amount of information about the close interaction between the community of edaphic fauna and plant species, especially because they provide a large amount of organic matter and their roots exudates to the soil, which are captured by litter and reintegrated into the soil with the help of degrading organisms (Bardgett and Wardle, 2010). This litter has mainly a structural function for oribatids, maintaining habitat heterogeneity necessary to sustain their complex communities, without significant influence

of the identity of the litter (even with more than 25 species of leaves) on the community of these mites (Kaneko et al., 2005), this is due to the decrease of leaf litter quality as the decomposition process progresses, and also to the high range of food resources that can be consumed by the oribatids (Scheu, 2005; Kaneko et al., 2005).

Contrary to our first hypothesis, specific identity of the trees studied (*A. mexicanum* and *G. glabra*) is not a determinant factor on the communities structure of soil oribatids in this tropical forest, so there are no significant differences in abundance, richness, dominance, equity and diversity; also, a similarity of 72% was observed among their species, and many of them were represented by a single specimen (*Appendix 1*). This can be because the litter under these plants in natural conditions is still heterogeneous and the decomposition process and abundant rains unmasks the possible differences between types of litter and generates a redistribution of organic matter and nutrients (Donoso et al., 2013). Finally, because the low evolutionary relationship between these mites and the plant resources they ingest, is common to find oribatids with general food habits (Wardle, 2006; Donoso et al., 2010, 2013) feeding indistinctly of any type of organic matter.

It is known that the abundance of mites depends on the seasonality of the ecosystems, since the quantity and quality of the organic matter in litter varies with the season and climate. In a tropical forest in Panama, a decrease in the abundance and richness of oribatids was observed in the last months of the year (November) since litter tended to be shallower (Donoso et al., 2013).

In this study, the total abundance (2,577 specimens) and richness (72 spp.) was lower than that reported by Minor et al. (2017a), who registered 10,585 specimens and 139 spp. in a tropical forest of Vietnam. Also the density of oribatids per sample in this forest goes from 12 to 984 ind/m<sup>2</sup>, with a monthly mean of 289.5 ind/m<sup>2</sup> (see *Table 1*) which was low compared to the records (between 4,000 and 40,000 ind/m<sup>2</sup>) for other tropical forests (Bluhm et al., 2016; Minor et al., 2017a); although there are records at the soil of rainforest Vietnam, with densities lower than 180 ind/m<sup>2</sup> (Minor et al., 2017b). The densities found in LTS are still below even compared with a dry forest in western Mexico, where densities greater than 8,000 ind/m<sup>2</sup> have been recorded (Palacios-Vargas et al., 2007).

In respect to our second hypothesis, our results show a similar tendency in the decrease of oribatids abundance at winter season, which is generally related to a reduction in the specific richness and diversity in the community, registering the three lowest abundances in December, January and February, and the highest in March, which is explained by the presence of a large number of tropical and northern cyclones that naturally occur in the region in the winter season from November to January (Soto and Gama, 1997), and that during our sampling, they were present very intensively from October to February, flooding large areas of the jungle and part of our collection points (University Network of Atmospheric Observatories, RUOA, http://www.ruoa.unam.mx), which generates a large number of soils oribatids perish, migrate vertically, or they resort to some morphophysiological strategy to survive, however the success and survival time to the floods is dependent on each species (Bardel and Pfingstl, 2018; Smrź, 1996; Pequeno et al., 2017), also only the families Scheloribatidae, Oppidae, Oripodidae, Protoribatidae and Arceremaeidae were abundant in this forest which possess generalist feeding habits, contrary to our expectations Phthiracaridae and Carabodidae was low abundant families.

The edaphic temperature result one of the main determinants of community structure of oribatids, since there is a great dependence of poikilothermic animals with this parameter for physiology (mainly metabolic and respiratory) throughout their life cycle (Stamou et al., 1995); this relationship is generally reported as negative, so that as the temperature increases, the abundance of many groups of the mesofauna decreases, among them the oribatid mites. Maximum lethal temperatures for them are close to 40 °C (Wehner et al., 2018; Ermilov and Lochynska, 2008; Bezci et al., 2017), other factors that significantly influence these communities are content of organic matter, soil pH, porosity and humidity (Urhan et al., 2006; Wissuwa et al., 2013); however, in our study none of these parameters were significant, suggesting that among the factors analyzed, only the soil temperature plays a key role in structuring oribatids in this rainforest.

The analysis of canonical correspondence explains about 60% of the variance of the community of oribatids in relation to temporality and the percentage of CO<sub>2</sub>, the temporality has been previously addressed as a structuring character of the communities of these mites; however the CO<sub>2</sub> has been used as a measure of the productivity of the system, observing that the greater amount of this compound, tropical plant species increase their photosynthetic rate, increasing their productivity and possibly their hydric status (Herrera et al., 2001). However, high levels of CO<sub>2</sub> generate changes in the edaphic flora and microbiota, which in short-term studies do not show enough interaction to modify the structure of the oribatid mites (Haimi et al., 2005), although in studies of modification of the amount of CO<sub>2</sub> in soil in the long term, after 18 months in plots with increase of this compound with 200 ppm above the environmental values, there are significant differences in the decrease of the populations of these mites in up to 61%, due to the variation in the microbiota and litter quality (Hansen et al., 2001).

## Conclusions

No significant effect of tree identity was found on the structure of the oribatid mite community in Los Tuxtlas rainforest. Soil constitutes a continuum in conditions and resources as proposed by Wehner et al. (2016) in its hypothesis about litter, being considered as a connecting bridge between the organisms; besides that litter quality decreases as the decomposition process advances and therefore they end up masking the differential properties of leaves (Scheu, 2005; Kaneko et al., 2005); however, it is relevant to mention that contrary cases have been reported for temperate forests (Eissfeller et al., 2013).

The community structure of oribatids mites showed significant differences in relation to collecting months, finding in general terms two large demographic increases in March 2016 and July 2016, which show a differentiation in the specific composition and allow a greater richness in the community.

Within the soil abiotic factors only soil temperature had a significant relationship with soil community according to Pearson correlation analysis; however, in the CCA ordination with envfit, additionally to temporality and edaphic temperature, the % of  $CO_2$ , the edaphic relative humidity, percentage of O.M. and O.C. was also significant and have an effect on the structuration. Even so, analyzed factors are insufficient to explain the whole variation in the community structure of the Oribatid mites.

Subsequent analyzes are necessary to know if the plant identity does not affect the communities of oribatid mites inhabiting the litter or even the trunks or canopy of morphological and functionally contrasting trees in this tropical ever-green forest, and also compare these results with others tropical forest for the world.

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### APPENDIX

Taxonomic	Genus and species		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	N total	N relative
Enarthronota															
Cosmochthoniidae	Cosmochthonius sp. nov.										G			1	NA
Hypochthoniidae	Eohypochthonius beckii					G	А	А		А			G	9	0.003
Haplochthonidae	Haplochthonius clavatus							G						1	NA
Mesoplophoridae	Mesoplophora longisetosa	G,A	G	G,A		G,A								64	0.025
Mesoplophoridae	Mesoplophora ca. silvaticus						А							1	NA
Lohmanniidae	Lohmannia sp. nov.							А						1	NA
Lohmanniidae	Torpacarus sp.	G,A	А	G,A		А	G				А			37	0.014
Lohmanniidae	Torpacarus ommitens		G,A		А	G,A	G,A	G,A	А	G,A	А	G,A	G	45	0.017
Mixonomata															
Dichosomata															

*Appendix 1.* Taxonomic list, occurrence and abundance of oribatid mites from the Los Tuxtlas Tropical Field Station related to A. mexicanum (A) and G. glabra (G)

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Epilohmannidae	Epilohmannia minuta					G,A	А	G						4	0.002
Epilohmannidae	Epilohmannia pallida			G,A		G,A		G		G,A				9	0.003
Euphthiraridae	Acrotritia ardua	А	G,A	А	G		G							8	0.003
Euphthiraridae	Euphthiracarus ca. breviculus							G	G		G			5	0.002
Phthiracaridae	Hoplophorella sp.1		G,A	G,A	G	G,A	G				А	G,A		25	0.010
Phthiracaridae	Hoplophorella scapellata	G,A	G,A	G,A	А	А	А		А	G				24	0.009
Phthiracaridae	Hoplophorella ca. eximia		G	А	G,A	G	G,A					G		8	0.003
Holosomata															
Trhypochthoniidae	Archegozetes magnus		G	А				G,A	G					31	0.012
Crotoniidae	Camisia ca. horrida		G,A											6	0.002
Malaconothridae	Malaconothrus ca. silvaticus	G			G									2	0.001
Brachypylina															
Pychonoticae	<b>T</b> ,													222	0.000
Arceremaeidae	Tecteremaeus cornutus	G,A	G,A	G,A	G,A	G,A	G,A	G,A	G,A	G,A	А	Α	G	10	0.086
Basilobelbidae	Basilobelba sp.	G,A	Α	G	Α	G					А			10	0.004
Compactozetidae	Reticulocepheus ca. granais	G,A	G,A	G	G	G,A	G	G,A	Α					38	0.015
Charassobatidae	Charassobates tuberosus	G,A	G,A		G	G,A	G			G	А	G		17	0.007
Carabodidae	Cubabodes verrucatus	G,A	G,A	G,A	G,A	G,A	G,A	G	G	G,A	G,A	G		65	0.025
Carabodidae	Carabodes (Klapericches)				G		G							2	0.001
	sp. nov.														
Carabodidae	(Phyllocarabodes) sp			G		А								4	0.002
Ceratoppiidae	(Provide and Sources) sp. Ceratorchestes baloghi				C	C	C			C				17	0.007
Cymbaeremaeidae	Scapheremaeus tonathiu	А	А	A	G	G	G		А	G	А			1	NA
Damaeidae	Enidamaeus sp. nov	<b>C</b> 1		G	C	C	C	6						10	0.004
Dampfiellidae	Dampfiella procera	G,A			G	6	G	G	<b>C</b> 1					8	0.004
Fremulidae	Fremulus rigidisetosus	A			6	A	G	A	G,A					25	0.005
Tetracondylidae	Elagellocenheus sagittatus	G,A			G,A	G,A	G	G	G,A	G,A				3	0.010
Damaeoliodidae	Fosseremus ca laciniatus		А					_	А					1	0.001
Hermanniellidae	Hermaniella sp. pov				-			G						6	0.001
Hermannendae	Sacculobates co				G	А	A							0	0.002
Hermanniellidae	heterotrichus						G			G				3	0.001
Hermanniellidae	Sacculobates horologiorum	G,A	G,A	А	G,A	G,A	G,A	G	G	G		G		39	0.015
Heterobelbidae	Heterobelba oxapampensis	А												1	NA
Xenillidae	Xenillus ca. fazendae	G,A	А			G,A	А	А						8	0.003
Microtegeidae	Microtegeus similis					А								2	0.001
Microtegeidae	Microtegeus borhidii	G,A	А			G	G,A	G	А	G,A	А	А		56	0.022
Nanhermannidae	Cyrthermannia simplex	G,A	G,A	А	G,A	G,A	А	G		G		А	G	30	0.012
Nanhermannidae	Cyrthermannia ca. florens								А					1	NA
Neoliodidae	Teleioliodes madininensis	G,A	G,A	G	G	G,A	G,A	А	G,A	А	G	А	G	44	0.017
Oppiidae	Multioppia sp.	G,A	G,A	G,A	G,A	G,A	G	G	А	G,A	G,A	А	G	129	0.050
Oppiidae	Stachyoppia curvispina		А	А	G,A	G,A	G,A	G,A	G,A	G,A	G,A	G		112	0.043
Oppiidae	Arcoppia sp.				G,A		G	G,A	А	G,A	А			47	0.018
Poronoticae															
Ceratozetidae	Fuscozetes sp. nov.	G,A	А	А	А		G			А	А			26	0.010
Epactozetidae	Truncozetes sturmi	G,A	А	G,A	G	G,A	G,A	G,A	G,A	G,A	G,A	А	G	94	0.036
Galumnellidae	Galumnopsis sp. nov.	G,A	А			А	G	А		А				26	0.010
Galumnidae	Galumna (Orthogalumna) sp. nov.						G	G	G,A					4	0.002
Galumnidae	Notogalumna sp. nov.				А									1	NA
Galumnidae	Pergalumna dactylaris	G	А	G,A	G,A	А	G,A	G,A		G,A		А		27	0.010
Galumnidaa	Pergalumna	_												21	0 000
Garunnindat	hypergranulosa	G,A		A	A	G,A	G	А		G				<i>L</i> 1	0.000
Galumnidae	Pergalumna obsidiana	G	G			G		А	G,A	G,A				14	0.005
Galumnidae	Pergalumna ekaterinae	G,A	G,A	G,A	G,A	G,A	G,A	G	G,A	А	А	А	А	59	0.023
Galumnidae	Galumnidae gen. nov.	G,A	G,A	G,A	G,A	G,A	А	А	G,A	G,A	А	А	G	60	0.023
Haplozetidae	Rostrozetes. ca. dimorphochartes				G		А		G	G,A				7	0.003
Haplozetidae	Rostrozetes cubanus								А	А	А			3	0.001
Haplozetidae	Rostrozetes foveolatus	G,A	G,A	G,A	G,A	G,A	G,A	G,A	А	G,A	G,A	G,A		138	0.054

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Licneremaeidae	Licneremaeus discoidalis				G		G	G				G,A	G	9	0.003
Microzetidae	Berlesezetes peruensis					А				А				2	0.001
Microzetidae	Kalyptrazetes desaussurei		А			G,A			А	А	А			14	0.005
Microzetidae	Schalleria ca. mexicana	G,A			G	G,A	G,A	G	А					12	0.005
Oripodidae	Benoibates sp. nov.				G,A	208	0.081								
Oripodidae	Benoibates sp.1							G						1	NA
Oripodidae	Oripoda lobata				G,A		G,A	G	G,A	G,A	А	G		43	0.017
Oripodidae	Oripoda scissurata				G,A		А			А				6	0.002
Oribatellidae	Oribatella szaboi	G				G,A				G				5	0.002
Phenopelopidae	Eupelops suramericanus						А		G					2	0.001
Protoribatidae	Protoribates capucinus		А	G,A	G,A	G,A	G,A		А		А	А		49	0.019
Protoribatidae	Brasilobates sp. nov.	G,A	А	G,A	G	217	0.084								
Scheloribatidae	Scheloribates praeincisus				G,A	G,A	G,A	G,A	А	А	А	G	G	75	0.029
Scheloribatidae	Scheloribates ca. grandiporosus	G,A	G,A	G,A	G,A	G,A	G,A	G	G,A	G,A				245	0.095

N total = total abundance; N relative = relative abundance

**Appendix 2.** Kruskall-Wallis Post-hoc comparisons of collecting month with structural parameters of oribatid mites community from Los Tuxtlas, Veracruz. Dunn's test with Bonferroni adjustment. Scores below diagonal, p-value above diagonal. In bold in each side the significant values with  $\alpha = 0.05$ . Abundance (N) and density (ind/m<sup>2</sup>) registered the same tendency, for which only one is reported; Species richness (S); Dominance (D'); Shannon diversity (entropy) index (H') and true diversity (<sup>1</sup>D) registered the same tendency, for which only one is reported; Species)

Ind/m <sup>2</sup>	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Mar		1	1	1	1	1	0.0215	* 0.0154	* 0.071	0.0024*	* 0.0001*	0.0000*
Apr	1.483		1	1	1	1	1	1	1	0.427	0.035	0.0107*
May	2.148	0.666		1	1	1	1	1	1	1	0.301	0.112
Jun	1.830	0.347	-0.318		1	1	1	1	1	1	0.113	0.038
Jul	0.839	-0.643	-1.309	-0.990		1	0.336	0.258	0.853	0.058	0.0030*	0.0007*
Aug	1.180	-0.302	-0.968	-0.650	0.341		0.853	0.674	1	0.175	0.0115*	0.0032*
Sep	3.409	1.926	1.261	1.579	2.569	2.229		1	1	1	1	1
Oct	3.499	2.016	1.351	1.669	2.660	2.319	0.090		1	1	1	1
Nov	3.068	1.585	0.920	1.238	2.229	1.888	-0.341	-0.431		1	1	1
Dec	3.968	2.486	1.820	2.139	3.129	2.788	0.560	0.470	0.900		1	1
Jan	4.756	3.274	2.608	2.926	3.917	3.576	1.347	1.257	1.688	0.788		1
Feb	5.078	3.595	2.930	3.248	4.239	3.898	1.669	1.579	2.010	1.109	0.322	
S	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Mar		1	0.5017	1	1	1	0.0401	0.1228	0.4348	0.0061*	0.0006*	0.0000*
Apr	1.526		1	1	1	1	1	1	1	0.8904	0.1894	0.0288
May	2.428	0.901		1	1	1	1	1	1	1	1	0.5017
Jun	1.668	0.142	-0.760		1	1	1	1	1	1	0.2896	0.0474
Jul	0.338	-1.188	-2.089	-1.330		1	0.1241	0.3427	1	0.0223*	0.0026*	0.0002*
Aug	0.863	-0.663	-1.565	-0.805	0.525		0.5826	1	1	0.1333	0.0202*	0.0022*
Sep	3.236	1.710	0.808	1.568	2.898	2.373		1	1	1	1	1
Oct	2.901	1.375	0.473	1.233	2.563	2.038	-0.335		1.0000	1.0000	1.0000	1
Nov	2.479	0.953	0.052	0.811	2.141	1.616	-0.757	-0.422		1.0000	1.0000	0.5776
Dec	3.738	2.212	1.310	2.070	3.400	2.875	0.502	0.837	1.259		1.0000	1
Jan	4.288	2.762	1.861	2.621	3.950	3.426	1.053	1.388	1.809	0.551		1
Feb	4.855	3.329	2.428	3.187	4.517	3.992	1.619	1.954	2.376	1.117	0.567	
D'	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Mar		1	0.6354	1	1	1	1	0.6922	1	0.1044	0.1619	0.9349
Apr	-1.489		1	1	1	1	1	1	1	1	1	1

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May	-2.341	-0.852		1	1	1	1	1	1	1	1	1
Jun	-1.858	-0.370	0.482		1	1	1	1	1	1	1	1
Jul	-0.511	0.977	1.829	1.347		1	1	1	1	0.4844	0.7041	1
Aug	-0.752	0.736	1.588	1.106	-0.241		1	1	1	0.9197	1	1
Sep	-0.871	0.617	1.469	0.987	-0.360	-0.119		1	1	1	1	1
Oct	-2.308	-0.820	0.032	-0.450	-1.797	-1.556	-1.437		1	1	1	1
Nov	-1.743	-0.254	0.598	0.116	-1.231	-0.990	-0.871	0.566		1	1	1
Dec	-2.951	-1.463	-0.611	-1.093	-2.440	-2.199	-2.080	-0.643	-1.209		1	1
Jan	-2.813	-1.325	-0.473	-0.955	-2.302	-2.061	-1.942	-0.505	-1.071	0.138		1
Feb	-2.193	-0.704	0.148	-0.334	-1.681	-1.440	-1.321	0.116	-0.450	0.759	0.621	
H'	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Mar		1	0.4656	1	1	1	0.0484	0.3261	1	0.0051*	0.0019*	0.0001*
Apr	1.628		1	1	1	1	1	1	1	1	0.5414	0.0679
May	2.454	0.827		1	1	1	1	1	1	1	1	0.7964
Jun	1.776	0.148	-0.679		1	1	1	1	1	1	0.8031	0.1105
Jul	0.338	-1.290	-2.117	-1.438		1	0.1472	0.8234	1	0.0188*	0.0074*	0.0004*
Aug	0.804	-0.824	-1.650	-0.971	0.466		0.5756	1	1	0.0955	0.0418	0.0031*
Sep	3.181	1.554	0.727	1.406	2.844	2.377		1	1	1	1	1
Oct	2.580	0.952	0.125	0.804	2.242	1.776	-0.602		1	1	1	1
Nov	2.126	0.499	-0.328	0.351	1.789	1.322	-1.055	-0.454		1	1	0.3231
Dec	3.783	2.155	1.329	2.007	3.445	2.979	0.602	1.203	1.657		1	1
Jan	4.027	2.400	1.573	2.252	3.690	3.223	0.846	1.448	1.901	0.244		1
Feb	4.709	3.082	2.255	2.934	4.372	3.905	1.528	2.130	2.583	0.926	0.682	
J'	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Mar		1	1	1	1	1	1	1	1	1	1	1
Apr	-0.405		1	1	1	1	1	1	1	1	1	1
May	-0.109	0.296		1	1	1	1	1	1	1	1	1
Jun	-0.084	0.322	0.026		1	1	1	1	1	1	1	1
Jul	-0.354	0.051	-0.245	-0.270		1	1	1	1	1	1	1
Aug	-0.595	-0.190	-0.486	-0.512	-0.241		1	1	1	1	1	1
Sep	0.885	1.290	0.994	0.968	1.239	1.480		0.9938	0.3508	1	0.56	1
Oct	-1.284	-0.878	-1.174	-1.200	-0.930	-0.689	-2.169		1	1	1	1
Nov	-1.670	-1.264	-1.560	-1.586	-1.316	-1.075	-2.555	-0.386		1	1	0.4734
Dec	0.171	0.576	0.280	0.254	0.524	0.766	-0.714	1.454	1.840		1	1
Jan	-1.503	-1.097	-1.393	-1.419	-1.149	-0.907	-2.387	-0.219	0.167	-1.673		0.7438
Feb	0.779	1.184	0.888	0.862	1.133	1.374	-0.106	2.062	2.448	0.608	2.281	