American Journal of Entomology
2023; 7(2): 30-37
http://www.sciencepublishinggroup.com/j/aje
doi: 10.11648/j.aje.20230702.11
ISSN: 2640-0529 (Print); ISSN: 2640-0537 (Online)

Spatiotemporal Diversity of Scolytinae (Coleoptera: Curculionidae) in Three Ecosystems of Villaflores, Chiapas

Carlos Eduardo Aguilar-Castillo[1], Eduardo Aguilar-Astudillo[2, *], Armando Equihua-Martínez[1], Obdulia Lourdes Segura-León[1], Edith Guadalupe Estrada Venegas[1], Carlos Joaquin Morales-Morales[2]

[1]Phytosanitary Institute, Postgraduate College, Montecillo, Mexico

[2]Faculty of Agricultural Sciences, Autonomous University of Chiapas, Villaflores, Mexico

Email address:

carlos_casti1@outlook.com (Carlos Eduardo Aguilar-Castillo), equihuaa@colpos.mx (Armando Equihua-Martínez), eduardo.aguilar@unach.mx (Eduardo Aguilar-Astudillo), sleon@colpos.mx (Obdulia Lourdes Segura León), carlos.mmorales@unach.mx (Carlos Joaquin Morales-Morales), edith_ev@yahoo.com.mx (Edith Guadalupe Estrada Venegas)

[*]Corresponding author

To cite this article:

Carlos Eduardo Aguilar-Castillo, Eduardo Aguilar-Astudillo, Armando Equihua-Martínez, Obdulia Lourdes Segura-León, Edith Guadalupe Estrada-Venegas, Carlos Joaquin Morales-Morales. Spatiotemporal Diversity of Scolytinae (Coleoptera: Curculionidae) in Three Ecosystems of Villaflores, Chiapas. *American Journal of Entomology*. Vol. 7, No. 2, 2023, pp. 30-37. doi: 10.11648/j.aje.20230702.11

Received: April 3, 2023; **Accepted**: May 2, 2023; **Published**: May 10, 2023

Abstract: The diversity of scolitines associated with jungles and a rustic coffee plantation in the municipality of Villaflores, Chiapas, was determined during the period from August 2020 to July 2021. The insects were captured using Ecoiapar traps with ethyl alcohol as attractant. A total of 3745 individuals of scolitines were collected, grouped into 28 genera and 64 species; the species Corthylus rubricollis and Cryptocarenus laevigatus are new records for Mexico. In jungles and coffee plantations, the richest genera were Corthylus, Xyleborus, Hypothenemus and Cryptocarenus. The maximum index of diversity of scolitines determined with the Shannon-Wiener index was in the locality of Guaymas (H': 2.979); with the Margalef index, the maximum specific richness was in Roblada (DMG: 7.073). On the other hand, with the equity index, the maximum value was obtained in Guaymas (J': 0.7654); while, with the Jaccarf similarity index, the Guaymas-Roblada localities present a greater number of species in common. The scolitine population fluctuated constantly, presenting two very marked population peaks, the first in the winter season in March with 782 individuals, the second in the summer in September with 62 individuals. By locality, the populations of scolitines fluctuated constantly, with the highest number of insects recorded in the winter and spring seasons, during the dry season and at the beginning of the rainy season.

Keywords: Diversity, Escolitinos, Jungles, Coffee, Villaflores

1. Introduction

Villaflores is a municipality in the state of Chiapas that stands out for its agricultural and livestock production at the regional and state level; Environmentally, it is characterized by presenting great wealth of natural resources and diversity of flora and fauna [1]. However, studies of insect diversity in Villaflores are few and are oriented towards crops of agricultural importance such as canavalia and piñon [2, 3] and beetles. melolontids and the superfamily Curculionoidea [4, 5]. However, in Villaflores no studies of scolitine diversity have been carried out, being these of great importance in agricultural and forestry crops in Mexico.

The beetles of the Scolytinae subfamily (Coleoptera: Curculionidae) present worldwide distribution and different roles in nature. Due to their feeding habits they are classified as spermatophages, myelophages, bark-eaters, borers and ambrosia, and due to their ecological interactions they are considered important components of ecosystems by contributing to the stability and nutrient balance of plant communities [6]. In the world, around 6000 species of scolitins distributed in 247 genera are known [7, 8]. In Mexico, there are around 870 species in 91 genera [9, 10]; of these, less than 5% are considered phytosanitary and

quarantine pests of economic importance, for infesting trees, shrubs and herbs of forestry, fruit and ornamental interest [6, 11]. However, phytosanitary problems in relation to scolitins arise from native or introduced species, which establish themselves in plants affected by biotic and abiotic factors [12, 13].

In many parts of Mexico, diversity and monitoring work has been directed at pine forests and crops of economic interest such as cocoa, avocado and teak [14, 13, 6], while in tropical and subtropical zones they are oriented towards natural vegetation and mangroves [15, 16, 17]. In general, the scolitines represent a great threat to these ecosystems and agroecosystems; therefore, the knowledge of diversity through the registration of species and location zones are important tools for the prevention of affectations through the timely detection of species of economic importance [18]. Some examples of complex ecosystems where the interaction of plants and scolitine species need better exploration are forests and some crops associated with these ecosystems, such as coffee plantations; where the works in relation to scolitin diversity are scarce, and focus on species of economic importance that damage the fruit, branches and shoots of the coffee plant [19, 20, 21]. Therefore, the objective of this research was to know the spatiotemporal diversity of scolitine species in forests and a coffee plantation in the municipality of Villaflores, Chiapas.

2. Materials and Method

Study zone. The collection of insects was carried out in three locations in the municipality of Villaflores, Chiapas. The towns of Jesús María Garza (16° 41' 91¨ N and 93° 26' 24¨ W) and Roblada (16° 39' 01¨ N and 93° 24' 67¨ W) are made up of low deciduous forest vegetation, while Guaymas (16° 46' 92¨ N and 93° 24' 43¨ W) is made up of semi-deciduous forest vegetation with rustic or mountain coffee plantations. The municipality presents an average annual temperature that ranges between 14 and 27°C, with average rainfall that ranges from 1,000 to 3,500 mm; the predominant climates are semi-warm and warm sub-humid with rains in summer (13.05 and 60.30%); the dominant types of vegetation are forests and jungles (low and medium) with 32.21 and 15.77% respectively [22, 23].

Trap setting. In each locality, ten Ecoiapar artisanal traps described by Barrera and collaborators in 2004 [24] and modified by Moreno y collaborators in the year 2005 [25]. Each trap was labeled with the name of the location, date, and trap number. The separation between the traps was 50 m, each one suspended 1.5 m above the ground on tree branches and held from the top and bottom to prevent them from falling due to the wind. The traps were placed in a transect in plots of 2 ha. In the middle part of each trap, the bait was set, consisting of 50 ml Falcon tubes with 96% ethyl cane alcohol, which was released through two one-millimeter-diameter holes located in the upper part of the bottle. The collecting vessel was provided with 200 ml of propylene glycol (antifreeze) diluted in water to 50 % to preserve the captured specimens until their collection.

Insect collection and identification. The collection of insects was carried out on a monthly basis, during the sampling period from August 2020 to July 2021. The captured insects were placed in Ziploc® bags with their respective data and 70% alcohol for their conservation. The samples were taken to the Forest Entomology laboratory of the Postgraduate College; for their separation, counting and mounting on entomological pins. The taxonomic determination of species was carried out using the taxonomic keys of [26, 27, 28]; in addition to comparisons with specimens deposited in the insect collection of the Colegio de Postgraduados, Campus Montecillo, Texcoco, State of Mexico. Species corroboration was performed by Dr. Armando Equihua Martinez.

Data analysis to determine the diversity of scolitins. In order to know and compare the diversity of scolitins in coffee plantations in the three study sites, the Shannon-Wiener (H´) diversity indices were applied, which measures the structure of the community through the uniformity of the importance values at across all species in the sample; the Margalef index (DMG), which is based on the specific richness of species, and the Pielou equity index (J´), which measures the proportion of observed diversity in relation to the maximum expected diversity [29, 30]. Subsequently, to know the proportions or differences of species between the study sites, the Jaccard index (Ij) was used, which expresses the degree to which various sites are similar due to the species present in them [29]. The analyzes were performed using the statistical program PAST3 version 3.20.

3. Results

Analysis to determine the richness and abundance of scolitins in forests and a coffee plantation 3,745 scolitins individuals belonging to 64 species and 28 genera were collected; of these, the species Corthylus rubricollis Blandford and Cryptocarenus laevigatus Blandford, constitute new records for Mexico; for Chiapas, 23 new species were registered, which represent an increase of 13.52% in relation to the species of scolitines previously registered in the state [31, 32, 33]. In the three study locations, the genera with the greatest richness were Corthylus, Xyleborus, Hypothenemus and Cryptocarenus with 10, 7, 7 and 6 species, respectively (Table 1).

According to the localities, in Roblada the greatest abundance of scolitines was recorded with 1,559 specimens, compared to Guaymas and Jesús María Garza, where 1,304 and 882 individuals were captured, respectively. On the other hand, in the three locations the most abundant species were *Xyleborus spinulosus* Blandford (14.29%), *Taurodemus sharpi* Blandford (11.75%), *Premnobius cavipennis* Eichhoff (10.81%) and *C. rubricollis* (10.17%), equivalent to 42.02 % in comparison with the rest of the scolitin species. By locality, the same species of scolitins were found, but in different percentages; In Roblada the abundant species were *X. spinulosus* (27.45%), *C. papulans* (11.48%), *P. cavipennis*

(11.1%), *C. rubricollis* (10.52%), *C. detrimentosus* (5.97%), *A. brevipennis* (4.3%) and *H. seriatus* (3.08%), which are equivalent to 73.9% of the rockfish captured for this locality. In Guaymas, the abundant species were *T. sharpi* (18.63%), *C. rubricollis* (13.11%), *P. cavipennis* (7.29%), *C. detrimentosus* (7.06%), *C. fuscus* (6.83%) and *A. brevipennes* (5.83%), which represent 58.75% of the total collected; while in Jesús María Garza the abundant species were *T. sharpi* (20.29%), *C. papulans* (16.33%), *P. cavipennis* (15.53%), *A. brevipennis* (8.5%), *C. fuscus* (7.71%), *X. spinulosus* (7.03%) and *C. rubricollis* (5.22%) with 80.61% of the total scolitinins collected (Table 1).

Table 1. *Richness and abundance of scolitins collected in ethanol traps in the localities of Roblada (RO), Guaymas (GU) and Jesus Ma. Garza (JMG) in Villaflores, Chiapas.*

Especies de Scolytinae	RO	GU	JMG	HA	Total	%
Ambrosiodmus hagedorni (Iglesias)	4	1	0	xl	5	0.13
Ambrosiodmus obliquus (LeConte)[2]	0	1	1	xl	2	0.05
Amphycranus brevipennis (Blandford)	67	76	75	xm	218	5.82
Bothrosternus foveatus (Blackman)	0	1	0	xm	1	0.03
Coccotrypes aciculatus (Schedl)	0	0	1	xm	1	0.03
Coptoborus pseudotenuis (Schedl)[2]	0	1	0	xm	1	0.03
Corthylocorus aguacatensis (Schedl)[2]	0	4	1	xl	5	0.13
Corthylus collaris (Blandford)	26	25	9	xm	60	1.6
Corthylus detrimentosus (Schedl)[2]	93	92	28	xm	213	5.69
Corthylus flagellifer (Blandford)	21	11	2	xm	34	0.91
Corthylus fuscus (Blandford)[2]	27	89	68	xm	184	4.91
Corthylus luridus (Blandford)[2]	9	6	0	xm	15	0.4
Corthylus nudus (Schedl)	0	16	1	xm	17	0.45
Corthylus panamensis (Blandford)	1	3	3	xm	7	0.19
Corthylus papulans (Eichhoff)	179	34	144	xm	357	9.53
Corthylus rubricollis (Blandford)[1]	164	171	46	xm	381	10.17
Corthylus villus (Bright)	4	4	2	xm	10	0.27
Cryptocarenus heveae (Hagedorn)[2]	23	8	9	ml	40	1.07
Cryptocarenus diadematus (Eggers)	33	4	3	ml	40	1.07
Cryptocarenus spatulatus (Wood)[2]	1	0	0	ml	1	0.03
Cryptocarenus laevigatus (Blandford)[1]	0	2	0	ml	2	0.05
Cryptocarenus lepidus (Wood)[2]	9	46	14	ml	69	1.84
Cryptocarenus seriatus (Eggers)[2]	1	0	0	ml	1	0.03
Dryocoetoides capusinus (Eichhoff)	0	0	1	xm	1	0.03
Dryocoetoides tuberculatus (Pérez & Atkinson)[2]	1	1	0	xm	2	0.05
Dryocoetes autographus (Ratzeburg)[2]	1	0	0	fl	1	0.03
Euwallacea posticus (Eichhoff)	1	2	3	xm	6	0.16
Hylocorus nodulus (Wood)[2]	4	2	0	xl	6	0.16
Hylocorus ruber (Wood)[2]	1	0	0	xl	1	0.03
Hypothenemus eruditus (Westwood)	18	42	8	fl	68	1.82
Hypothenemus hampei (Ferrari)	34	40	4	es	78	2.08
Hypothenemus seriatus (Eichhoff)	48	46	11	ml	105	2.8
Hypothenemus setosus (Eichhoff)	8	2	2	fl-ml	12	0.32
Hypothenemus interstitialis (Hopkins)	14	0	0	fl-ml	14	0.37
Hypothenemus pubescens (Hopkins)[2]	2	0	0	fl-ml	2	0.05
Hypothenemus crudiae (Panzer)	14	7	3	fl	24	0.64
Loganius squamifer (Wood)	1	0	0	fl	1	0.03
Micracis festiva (Wood)	1	1	0	xl	2	0.05
Micracis torus (Wood)[2]	5	3	3	xl	11	0.29
Micracis unicornis (Wood)	2	0	0	xl	2	0.05
Micracisella hondurensis (Wood)	4	3	2	fl	9	0.24
Monarthrum ferrari (Blandford)[2]	1	0	0	xm	1	0.03
Monarthrum robustum (Schedl)	1	2	0	xm	3	0.08
Monarthrum exornatum (Schedl)	6	10	0	xm	16	0.43
Microcorthylus minimus (Schedl)[2]	11	25	2	xm	38	1.01
Premnobis cavipennis (Eichhoff)	173	95	137	xm	405	10.81
Pityophthorus attenuatus (Blackman)[2]	3	0	1	fl	4	0.11
Pityophthorus sp.	0	0	2	fl	2	0.05
Pycnarthrum hispidum (Ferrari)[2]	0	1	0	fl	1	0.03
Scolytodes ingavorus (Wood)	0	1	0	fl	1	0.03
Taurodemus sharpi (Blandford)	18	243	179	xm	440	11.75
Thysanoes mexicanus (Wood)[2]	6	5	0	xl	11	0.29
Thysanoes lobdelli (Blackman)[2]	1	0	0	xl	1	0.03
Tricolus difodinus (Bright)	10	6	4	xm	20	0.53
Tricolus nodifer (Blandford)	17	28	2	xm	47	1.26
Xileborinus gracilis (Eichhoff)	8	5	2	xm	15	0.4

Especies de Scolytinae	RO	GU	JMG	HA	Total	%
Xyleborus affinis (Eichhoff)	14	31	6	xm	51	1.36
Xyleborus bispinatus (Eichhoff)[2]	15	21	5	xm	41	1.09
Xyleborus ferrugineus (Fabricius)	5	8	6	xm	19	0.51
Xyleborus horridus (Eichhoff)	1	0	1	xm	2	0.05
Xyleborus spinulosus (Blandford)	428	45	62	xm	535	14.29
Xyleborus volvulus (Fabricius)	15	21	8	xm	44	1.17
Xylosandrus curtulus (Eichhoff)	4	12	18	xm	34	0.91
Xylosandrus morigerus (Blandford)	1	1	3	xm	5	0.13
Insectos colectados	1559	1304	882		3745	100
Número de especies	53	49	41		64	

Nuevos registros para México[1]. Nuevos registros para Chiapas[2]. HA: hábito alimenticio determinado por Wood (1982): fl: fleófago, ml: mielófago, xm: xilomicetófago, xl: xilófago, es: espermatófago.

Table 2. *Diversity indices of scolitines from the towns of Roblada (RO), Guaymas (GU) and Jesus M. Garza (J.M.G.) of Villaflores, Chiapas.*

Location	Number of individuals	Number of species	Diversity			Equity
			H´	D_{MG}	I_s	*J´*
RO	1559	53	2,72	7,073	0,8787	0,685
GU	1304	49	2,979	6,692	0,9205	0,7654
J.M.G.	882	41	2,571	5,898	0,8847	0,6924

H´: Shannon-Wiener index; DMG: Margalef index; Is: Simpson index J´: Pielou equity index

With the Shannon-Wiener index (H´) it was obtained that the maximum diversity of scolitins was found in Guaymas (H´: 2,979) and the minimum in Jesus Maria Garza (H´: 2,571); with the Margalef index (DMG) it was determined that the maximum specific richness occurs in Roblada (DMG: 7,073) and the minimum in Jesus Maria Garza (DMG: 5,898). Regarding the equity index (J´), the maximum value was obtained by Guaymas (J´: 0.7654); while the lowest value was Roblada (J´: 0.685) (Table 2). On the other hand, the Jaccard similarity index (Ij) determined that the Guaymas-Roblada localities present a greater number of species in common (Ij: 0.672) compared to the Guaymas-Jesus Maria Garza localities (Ij: 0.666) and Roblada- Jesus Maria Garza (Ij: 0.593) (Figure 1).

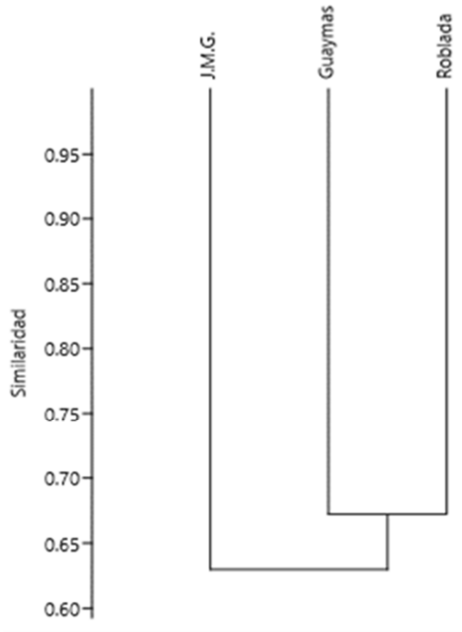

Figure 1. *Jaccard similarity dendrogram of scolitins from the Roblada, Guaymas and Jesús Ma. Garza (J.M.G.) localities in Villaflores, Chiapas.*

The population fluctuation of scolitines in jungles and a rusticano coffee plantation in Villaflores, Chiapas. In each location, two population peaks were recorded throughout the study year; the first in winter in the month of March with 782 individuals, the second in the spring season in the month of June with 637 individuals. On the other hand, in summer during September the lowest abundance of insects was presented with 62 individuals captured (Figure 2).

On the other hand, the species with the highest abundance in the three sampling locations were *X. spinulosus*, *T. sharpi*, *P. cavipennis*, *C. rubricollis* and *C. papulans* with 535, 440, 405, 381 and 357 individuals respectively. The populations of these insects fluctuated considerably during the monitoring year; the scolitins *X. spinulosus*, *T. sharpi* and *P. cavipennis* reached their highest population abundances in the month of March with 215, 207 and 218 individuals respectively, to drastically decrease their populations during the year. In contrast, the populations of the species *C. rubricollis* and *C. papulans* fluctuated uniformly, presenting their highest population abundance in the months of June and January with 84 and 49 individuals respectively (Figure 3).

By locality, the populations of scolitines increased considerably in the months of collection; presenting for each locality two population peaks of greater abundance during the winter and spring seasons, that is, during the course of the dry season and the beginning of the rainy season. In Roblada, the months of greatest abundance were March and June with 353 and 313 individuals respectively. In this locality, the species with the highest population abundance were *X. spinulosus*, *C. papulans*, *P. cavipennis* and *C. rubricollis* with 428, 179, 173 and 164 individuals. In contrast, *C. panamensis*, *C. espatulatus*, C. seriatus, *D. autographus*, *D. tuberculatus*, E. posticus, H. ruber, L. squamifer, M. festiva, M. Ferrari, *M. robustum*, *T. lobdelli*, *X. horridus* and *X. morigerus* were recorded only once.

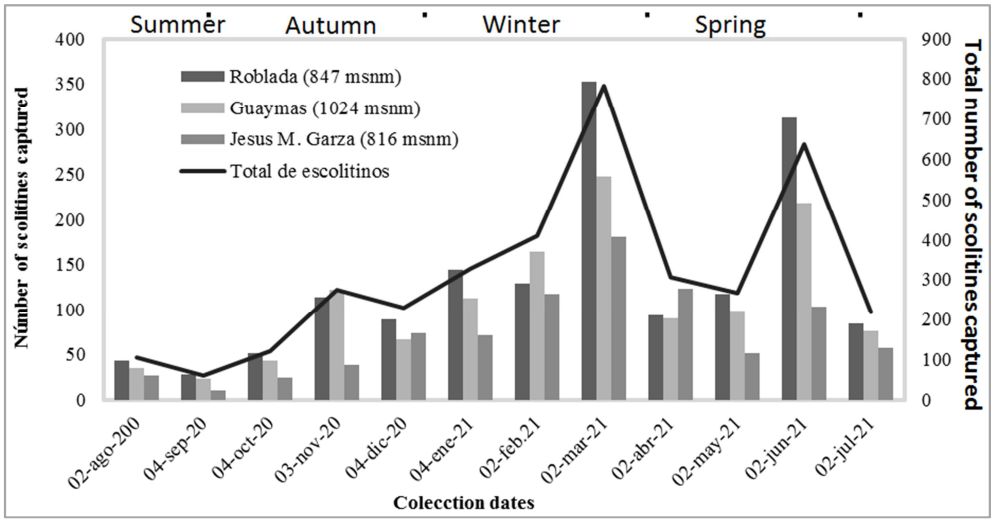

Figure 2. *Population fluctuation of scolitines captured with ethanol traps in Villaflores, Chiapas.*

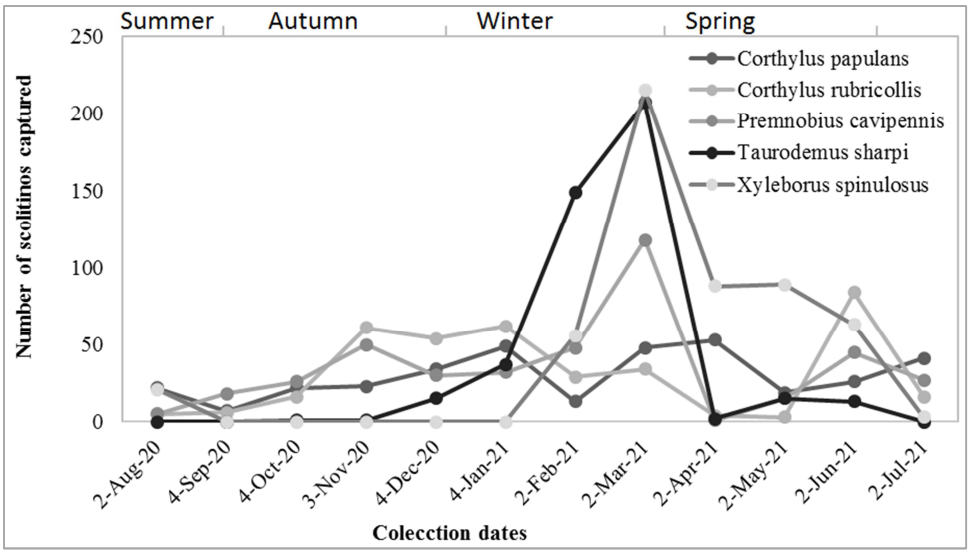

Figure 3. *Population fluctuation of the most abundant scolitins during the monitoring year in Villaflores, Chiapas.*

In Guaymas, the collection pattern was similar to Roblada, although with fewer captures on the two dates, that is, 248 and 219 individuals. In this locality, the most abundant species were T. sharpi, *C. rubricollis*, *P. cavipennis* and *C. detrimentosus* with 283, 171, 95 and 92 individuals; whereas, the species with only one individual were *A. hagedorni*, *A. obliquos*, *B. foveatus*, *D. tuberculatus*, *M. festiva*, *P. hispidum*, *S. ingavorus* and *X. morigerus*. Finally, in Jesus Maria Garza the pattern of maximum catches was different from the other two locations, in this case it was recorded in winter in the months of February, March and April with 118, 181 and 123 individuals. The species with the highest representation were *T. sharpi*, *C. papulans* and *P. cavipennis* with 179, 144 and 137 individuals. Instead, the species with unique records were *A. obliquos*, *C. aciculatus*, *C. aguacatensis*, *C. nudus*, *D. capucinus*, *P. attenuatus* and *X. horridus*.

4. Discussion

In the municipality of Villaflores, the diversity of scolitine species was high; with 24 new records for Chiapas, which represent an increase of 13.52%; In addition, Corthylus rubricollis and *Cryptocarenus laevigatus* are new records for Mexico, based on the research carried out by Equihua and Burgos in 2002 and Atkinson in 2021 [31, 33], who state that they have no records of these species in Mexico. On the other hand, the genera *Corthylus*, *Xyleborus*, *Criptocarenus* and *Hypothenemus* are the most abundant in the monitoring systems, they are considered common and abundant organisms as they present a high reproductive rate, a great variety of host plants and a wide distribution in tropical and subtropical regions of the world [26, 10]. Of the four genera, in the three study sites the genus *Corthylus* was the one with the highest species richness with ten species; These results are similar to what was reported in the cloud forest of Xalapa, Veracruz by Atkinson and Ibarra in 2021 [34], who report 16 *Corthylus* species. On the other hand, the diversity of species of the genera *Xyleborus* and *Hypothenemus* in Villaflores was relatively high, as in research carried out by Estrada and Atkinson, Pérez-De la Cruz and collaborators, and Falcón-

Brindis and collaborators in the year of 1988, 2009 and 2018 [35, 14, 36] in forest ecosystems, floodplain grasslands and mangroves, and in agricultural crops such as cocoa. In the case of the genus *Cryptocarenus*, six species were recorded, which contrasts with diversity studies in mangroves in Tabasco and avocado crops in Michoacán, where two and three species were captured respectively [37, 38].

By species, *X. spinulosus* was the most abundant scolithin during the annual monitoring cycle; However, despite being an insect that is commonly captured in various states of Mexico and other countries in the world, its populations are relatively low in natural vegetation and forest plantations in Ecuador [39] and jungles of Tabasco, Mexico [17]. While the records of *T. sharpi* are greater than those reported by other authors, even though it is a species with a wide distribution from southern Mexico to Panama [33], few studies report the presence of this species. Insect in tropical forests of southern Mexico (Chiapas, Oaxaca, Veracruz and Tabasco), where few individuals have been collected compared to those captured in the monitoring sites of this research [40, 17]. In the same way, the records of *P. cavipennis* were lower in coffee plantations with 95 individuals and abundant in low deciduous forests with 173 and 137 individuals, than those reported by Averos and collaborators in 2021 [41] who report 4170 individuals of this species in the central zone of the Ecuadorian coast. On the other hand, [42] Wood in 2007 describes *P. cavipennis* as a species with a wide geographical distribution; In the American continent it is found from the southern United States to Brazil, with a wide variety of hosts [42], this distribution in the world has allowed it to colonize various types of ecosystems such as tropical forests, floodplain grasslands, mangrove swamps and xeric scrub. [43, 36, 44, 37] and some economically important crops such as cocoa, avocado, teak and balso [45, 38, 46, 41]; In most of these investigations, the populations of *P. cavipennis* are low compared to that found in this study, with the exception of the results obtained by Falcón- Brindis and collaborators, Belezaca and collaborators, and Averos y collaborators in the years 2018, 2020 and 2021 respectively [36, 46, 41], where *P. cavipennis* was the dominant species. Finally, *C. rubricollis* was abundant in the low deciduous forest of Roblada and coffee plantations of Guaymas with 164 and 171 individuals respectively; In Mexico there is no record of this species in diversity studies and the little information comes from Central and South American countries such as Costa Rica, Panama and Colombia [47, 26, 48].

The diversity and similarity indexes used in each one of the localities, allowed to determine the differences in the diversity and abundance of species; The highest species richness using the diversity indices was recorded in the towns of Roblada and Guaymas, which present small significant differences in the results obtained, while Jesús Ma. Garza was the least diverse site; This difference was due to the elements that make up each environment, in which biotic factors such as temperature, humidity, precipitation and altitude, and abiotic factors such as food availability, predation and competition are those that determine the richness and abundance of these insects in various ecosystems. and agroecosystems [26, 14]. On the other hand, the equity index determined that in rusticano coffee the species are equally abundant, compared to localities with natural vegetation, [36] Falcón and collaborators in 2018, mention that modifying ecosystems for agricultural use contributes to the loss of the diversity of insects, but favors the establishment and increase of the populations of generalist and agriculturally important species, such as H. hampei, *H. interstitialis*, *X. affinis*, *X. volvulus* and *X. morigerus*. Finally, the similarity index showed that the Guaymas and Roblada localities present a greater number of species in common; compared to the towns of Roblada and Guaymas, despite being at the same altitude and type of low sub-deciduous forest vegetation.

5. Conclusion

This is the first contribution to the knowledge of the diversity, abundance, and population fluctuation of scolitines in forests and rusticano coffee plantations in the municipality of Villaflores, Chiapas. Which provides new records for the state of Chiapas and Mexico; and species of economic importance such as *H. hampei*, *X. curtulus*, *X. morigerus* and some species of the genus *Xyleborus*, which require follow-up to reduce their impact on crops, which can be with the use of artisanal traps baited with ethanol, which are accessible, easy to use and provide information on the population structure for decision-making in the management and control of these insects in various forest and agroforestry ecosystems where they live.

References

[1] Aguilar, R., J. Nahed, M. Parra, L. García y B. Ferguson. 2012. Medios de vida y aproximación de sistemas ganaderos al estándar de producción orgánica en Villaflores, Chiapas, México. *Revista de investigación y difusión científica agropecuaria*, 16 (3): 21-51.

[2] Morales-Morales, C. J., E. Aguilar-Astudillo, R. R. Quiroga-Madrigal y M. A. Rosales-Esquinca. 2011. Insectos asociados al fruto del piñon (*Jatropa curcas* L.) en los municipios de Villaflores y Villa Corzo, Chiapas, México. *Dugesiana,* 18 (1): 85-89.

[3] Montejo-Nango, A., C. J. Morales-Morales, E. Aguilar-Astudillo, J. C. Gómez-Castañeda y J. M. Cena-Velázquez. 2017. Chrysomelidae asociados al cultivo de *Canavalia ensiformis* L. (Fabales: Fabaceae) en Villaflores, Chiapas, México. *Entomología Mexicana,* 4: 338-340.

[4] Pacheco, F. C., A. E. Castro, R., M. A. Morón y B. Gómez, G. 2008. Fauna de escarabajos melolóntidos (Coleoptera: Scarabaeoidea) en el municipio de Villaflores, Chiapas, México. *Acta Zoológica Mexicana*, 24 (1): 139-168.

[5] Morales-Morales, C. J., J. C. Gómez-Castañeda, J. A. Medina-Meléndez, J. A. Espinosa-Moreno, A. Gutiérrez-Martínez y E. Aguilar-Astudillo. 2016. *Entomología Mexicana*, 3: 276-280.

[6] García-Guevara, J. F., C. J. García-Ávila, N. Acevedo-Reyes, y S. Vergara-Pineda. 2018. Escarabajos (Curculionidae: Scolytinae) asociados a trampas en huertos de *Persea americana* Miller, 1768 en cuatro municipios de Michoacán. *Entomología Mexicana,* 5: 408-414.

[7] Kirkendall, L. R., P. H. Biedermann y B. H. Jordal. 2015. Evolution and Diversity of Bark and Ambrosia Beetles. pp. 85–156. *In*: Vega, F. E. y R. W. Hofstetter (Eds.), Bark Beetles: Biology and Ecology of Native and Invasive Species. Academic Press, New York.

[8] Setiawan, Y., R. Rachmati, y H. Tarno. 2018. Diversity of ambrosia beetles (Coleoptera: Scolytidae) on teak forest in Malag Disctrict, East Java, Indonesia. *Biodiversitas,* 19: 1791-1797.

[9] Morrone, J. J. 2014. Biodiversidad de Curculionoidea (Coleoptera) en México. *Revista Mexicana de Biodiversidad,* 85: 312-324.

[10] Pérez-De La Cruz, M., M. A. Hernández-May, A. De La Cruz-Pérez, y S. Sánchez-Soto. 2016. Scolytinae y Platypodinae (Coleoptera: Curculionidae) de dos áreas de conservación en Tabasco, México. *Revista de Biología Tropical,* 64: 39-326.

[11] Atkinson, T. H. 2019. Escarabajos descortezadores y ambrosiales (Coleoptera: Curculionidae: Scolytinae, Platypodinae) de Sonora, México. *Dugesiana*, 25: 41-49.

[12] Eulogio, M. N., J. Cola Z., D. Pratissoli, y A. Sérgio F. 2000. Fluctuación poblacional de Scolytidae (Coleoptera) en zonas reforestadas con *Eucalyptus grandis* (Myrtaceae) en Minas Gerais, Brasil. *Revista de Biología Tropical*, 48: 101-107.

[13] Lázaro-Dzul, M. O., A. Equihua-Martínez, J. Romero-Nápoles, H. González-Hernández, J. E. Macías-Sámano, D. Alvarado-Rosales, y A. Castañeda-Vildózola. 2017. Captura de Scolytinae (Curculionidae) en trampas con atrayentes químicos en huertos de aguacate en San Juan Nuevo, Michoacán. *In:* Memorias del V Congreso Latinoamericano del Aguacate. Salazar-García S. y A. F. Barrientos-Priego (eds.). Ciudad Guzmán, Jalisco, México.

[14] Pérez-De La Cruz, M., A. Equihua-Martínez, J. Romero-Nápoles, S. Sánchez-Soto y E. García-López. 2009. Diversidad, fluctuación poblacional y plantas huésped de escolitinos (Coleoptera: Curculionidae) asociados con el agroecosistema cacao en Tabasco, México. *Revista Mexicana de Biodiversidad*, 80: 779-791.

[15] Pérez-De La Cruz, M., P. G. Zavaleta-Bastar, y A. De La Cruz-Pérez. 2015. Aproximación al conocimiento de la diversidad de Scolytinae y Platypodinae (Coleoptera: Curculionidae) asociados a selvas de Tabasco, México. *Entomotropica,* 30: 201-211.

[16] Hernández-Muñoz, G., y J. A. Obregón-Zúñiga. 2016. Fluctuación poblacional de descortezadores (Coleoptera: Curculionidae: Scolytinae) en bosques de pino (*Pinus* sp.) en Zimapán, Los Mármoles, Tlaxco, Hidalgo. *Entomología Mexicana,* 3: 639-643.

[17] Gerónimo-Torres, J. Del C., M. Pérez-De La Cruz, L. Arias-Rodríguez, A. De La Cruz-Pérez, y C. M. Burelo-Ramos. 2019. Diversidad y Fluctuación de las comunidades de escarabajos descortezadores y barrenadores (Coleoptera: Bostrichidae, Curculionidae: Scolytinae, Platypodinae) asociados a una selva en Tabasco, México. *Revista Chilena de Entomología,* 45: 37-49.

[18] Solano, A. E. H., C. E. Belezaca P., R. M. López T., y J. S. Montiel P. 2019. Diversidad de escolitinos en plantaciones de *Tectona grandis* l. f. (teca) en la provincia del Guayas, Ecuador. *Universidad y sociedad,* 11: 507-512.

[19] Barrera, J. F., J. Herrera, H. García, J. Villalobos, y J. Gómez. 2006. Monitoreo del taladrador de la rama del café robusta *Xylosandrus morigerus* con trampas de etanol-metanol en el Soconusco, Chiapas. *In*: Entomología mexicana. Estrada, E., J. Romero, A. Equihua, C. Luna, y J. L. Rosas (eds). México. *Sociedad Mexicana de Entomología,* 654-658 pp.

[20] Leiva-Espinosa, S., M. Oliva-Cruz, K. Rubio-Rojas, J. Maicelo-Quintana, y M. Milla-Pino. 2019. Uso de trampas de colores y atrayentes alcohólicos para la captura de la broca del café (*Hypothenemus hampei*) en plantaciones de café altamente infestadas. *Revista Colombiana de Entomología*, 45: 61-67.

[21] Aguilar-Astudillo E., C. J. Morales-Morales, M. A. Rosales-Esquinca, J. C. Gómez C., J. M. Ceña-Velázquez, y R. A. Alonso-Bran. 2019. Insectos asociados a cultivos de café en Simojovel de Allende, Chiapas, México. *Entomología Mexicana,* 6: 379-384.

[22] Instituto Nacional de Estadística, Geográfica e Informática (INEGI). 1995. Villaflores, estado de Chiapas: cuaderno estadístico municipal. Edición 1994. Chiapas, México. 103 p.

[23] Instituto Nacional de Estadística y Geografía (INEGI). 2013. Conociendo Chiapas / Instituto Nacional de Estadística y Geografía. México. INEGI. 36 p.

[24] Barrera, J. F., A. Villacorta, y J. Herrera. 2004. Fluctuación estacional de las capturas de la broca del café (*Hypothenemus hampei*) con trampas de etanol-metanol e implicaciones sobre el número de trampas. *Entomología Mexicana,* 3: 540-544.

[25] Moreno, D., González, H., Botta, E. Martínez, A., Ovies. J. 2005. Evaluación de la efectividad de trampas rústicas para la captura de hembras adultas de la broca del café *Hypothenemus hampei* (Coleoptera: Scolytidae). *Fitosanidad,* 9 (3): 27-30.

[26] Wood, S. L. 1982. The bark and ambrosia beetles of North and Central America (Coleoptera: Scolytidae), A taxonomic monograph. *Great Basin Natural Memories,* 6: 1-1359.

[27] Atkinson, T. H. 2010. New species and records of Cactopinus Schwarz with a key to species (Coleoptera, Curculionidae, Scolytinae). *ZooKeys,* 56: 17-33.

[28] Pérez-Silva, M., A. Equihua-Martínez, E. G. Estrada-Venegas, A. L. Muñoz-Viveros, J. M. Valdéz-Carrazco, J. Sánchez-Escudero, y T. H. Atkinson. 2015. Sinopsis de especies mexicanas del género *Xileborus* Eichhoff, 1864 (Coleoptera: Curculionidae: Scolytinae). *Acta Zoológica Mexicana,* (n.s.) 31: 239-250.

[29] Magurran, A. 1988. Ecological diversity and its measurement. Princeton University Press, New Jersey. 179 pp.

[30] Moreno, C. E. 2001. Métodos para medir la biodiversidad. M & T-SEA. Zaragoza. 84 pp.

[31] Equihua, M. A. y A. Burgos, S. 2002. Scolytidae. pp. 539-557. *In*: Biodiversidad, taxonomía y biogeografía de artrópodos de México: Hacia una síntesis de su conocimiento. Volumen III. Llorente J.; Monrrone J. J. (Eds.). CONABIO-IBUNAM. México. 690 p.

[32] Equihua-Martínez, A., E. G. Estrada-Venegas y A. Burgos-Sólorio. 2011. Descortezadores y barrenadores (Insecta: Coleoptera: Scolytidae). In: La biodiversidad de Veracruz: Estudio de Estado. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (Conabio) (Eds). Gobierno del Estado de Veracruz, Universidad Veracruzana, Instituto de Ecología, A. C. México.

[33] Atkinson, T. H. 2021. Bark and ambrosia beetles of the Americas. http://www.barkbeetles.info. Citado el 10 de octubre de 2021.

[34] Atkinson, T. H. and L. A. Ibarra J. 2021. Corrections and additions to the checklist of bark and ambrosia beetles (Coleoptera: Curculionidae: Scolytinae, Platypodinae) of mesic montane forest in Xalapa, Veracruz, Mexico. *The Coleopterists Bulletin,* 75 (1): 227-239.

[35] Estrada, V. A. y T. H. Atkinson. 1988. Scolytidae y Platypodidae (Coleoptera) de Escárcega, Campeche, México. Biogeografía, biología, importancia económica y una lista comentada de especies. *Anales del Instituto de Biología, Serie Zoología*, 58: 199-220.

[36] Falcón-Brindis, A., M. Pérez de la Cruz, E. E. Mata-Zayas, A. De la Cruz-Pérez, S. Sánchez-Soto y C. M. Burelo-Ramos. 2018. Scolytinae and Platypodinae (Coleoptera: Curculionidae) of Tabasco, México. *Acta Zoológica Mexicana,* 34 (2): 1-10.

[37] Gerónimo-Torres, J. del C., S. Oporto-Peregrino, M. A. Magaña-Alejandro, L. Ríos-Rodas, B. Sánchez-Díaz, R. Monroy-Hernández, y C. O. Pozo-Santiago. 2021. Distribución vertical de escarabajos descortezadores y barrenadores en una selva tropical. *Tropical and Subtropical Agroecosystems,* 24 (74): 1-17.

[38] Lázaro-Dzul, M. O., A. Equihua-Martínez, J. Romero-Nápoles, H. González-Hernández y D. Alvarado-Rosales. 2020. Diversity of Scolytinae (Coleoptera: Curculionidae) at three sites in the central avocado-producing region of Michoacan, Mexico. *The Coleopterists Bulletin,* 74 (2): 454-462.

[39] Martínez, M., A. I. Cognato, M. Guachambala and T. Boivin. 2019. Bark and Ambrosia Beetle (Coleoptera: Curculionidae: Scolytinae) Diversity in Natural and Plantation Forests in Ecuador. *Environmental Entomology,* 48 (3): 603-613.

[40] Atkinson, T. H. 2018. Anew species, new synonymy and new records of Mexican and Central American Xyleborini (Coleoptera: Curculionidae: Scolytinae). *Zootaxa,* 4442 (2): 1-6.

[41] Averos, J. B., J. Castro-Olaya, M. Martínez-Chevez, M. Guachambala-Cando, S. Peñarrieta-Bravo, D. Chirinos-Torres y L. García-Cruzatty. 2021. Fluctuación poblacional de P. cavipennis (Coleoptera: Curculionidae: Scolytinae) en plantaciones de balso (*Ochroma pyramidale*) en la zona enctral del litoral ecuatoriano. *Revista Colombiana de Entomología*, 47 (1): 1-7.

[42] Wood, S. L. 2007. Bark and Ambrosia Beetles of South America (Coleoptera: Scolytidae). Monte L. Bean Science Museum, Provo, Utah, 1-900.

[43] Quezada-García, R., E. Jiménez-Sánchez, A. Equihua-Martínez y J. Padilla-Ramírez. 2014. Escolitinos y platipodinos (Coleoptera: Curculionidae) atraídos a trampas tipo NTP-80 en Zapotitlán de las Salinas, Puebla, México. *Acta Zoológica Mexicana,* (n.s.) 30 (3): 625-636.

[44] Gerónimo-Torres, J. C., M. Pérez- De La Cruz, A. De La Cruz-Pérez, y M. Torres-De La Cruz. 2015. Scolytinae y Platypodinae (Coleoptera: Curculionidae) asociados a manglares de Tabasco, México. *Revista Colombiana de Entomología*, 41 (2): 257-261.

[45] Ángel-Restrepo, M., S. Ochoa-Ascencio, S. Fernández-Pavía, G. Vazquez-Marrufo, A. Equihua-Martínez, A. F. Barrientos-Priego, M. Correa-Suarez y J. R. Saucedo-Carabez. 2019. Identificación de escarabajos ambrosiales (Coleópteros: Curculionidae) asociados a árboles de aguacate en Michoacán, México. *Folia Entomológica Mexicana,* 5 (2): 80-88.

[46] Belezaca, C., E. Hidalgo, R. López y K. Macías. 2020. Taladradores de la madera (Scolytidae) en plantaciones de *Tectona grandis* L. F. (teca) del trópico ecuatoriano. *Alternativas,* 21 (3): 49-54.

[47] Wood, S. L. 1961. New records and species of Scolytidae (Coleoptera) from Colombia. *The Great Basin Naturalist,* 21 (1/2): 1-7.

[48] Wood, S. L., G. C. Stevens y H. J. Lezama. 1992. Los Scolytidae (Coleoptera) de Costa Rica: clave de subfamilia Scolytinae, tribu Corthylini. *Revista de Biología Tropical,* 40 (3): 247-286.