

Ecology

Community structure of Thomisidae (Araneae, Araneomorphae) in Tepoztlán, Morelos, Mexico: a one-year seasonal study

Estructura de la comunidad de Thomisidae (Araneae, Araneomorphae) en Tepoztlán, Morelos, México: estudio estacional de un año

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Abstract

Spiders of the family Thomisidae are scarcely studied in Mexico, and ecological data for this family are practically nonexistent. To fill this gap, we carried out an ecological study of crab spiders in a deciduous tropical forest in San Andrés de la Cal, Tepoztlán, Morelos, central Mexico, evaluating seasonal variation in community structure over the annual cycle. Fieldwork consisted of systematized monthly diurnal collections by 5 people, implementing 3 sampling techniques: beating sheets, sweeping nets, and looking down. In total, we collected 839 spiders representing 9 genera and 16 species, of which 5 genera and 7 species are new state records. The highest richness, abundance, and diversity were recorded in the rainy season; however, unique species were found during each season. According to richness estimators, between 12 and 22% of the estimated species remain to be found in the study area. Evenness factors indicated that the community is composed primarily of rare species, with only a few dominant species. While this study reports a reliable inventory for the region, the species accumulation curve did not reach the asymptote, suggesting that additional ecological studies employing diverse protocols are needed to complement our knowledge of these spiders.

Keywords: Crab spiders; Deciduous tropical forest; Ecology; Diversity; Seasonality

Resumen

En México, la familia Thomisidae está poco estudiada y los datos ecológicos son prácticamente inexistentes. Para subsanar esta deficiencia, realizamos un estudio ecológico de arañas cangrejo en un bosque tropical caducifolio en San Andrés de la Cal, Tepoztlán, Morelos, centro de México, evaluando la variación estacional en la estructura de la comunidad durante un ciclo anual. El trabajo de campo consistió en colectas diurnas mensuales sistematizadas por 5 personas, implementando 3 técnicas de muestreo: paraguas entomológico, red entomológica y búsqueda directa. En total, recolectamos 839 individuos pertenecientes a 9 géneros y 16 especies, de los cuales 5 géneros y 7 especies son nuevos registros estatales. La mayor riqueza, abundancia y diversidad se registraron durante la temporada de lluvias; sin embargo, se registraron especies únicas en cada temporada. Según los estimadores de riqueza, faltan por registrarse en el área de estudio entre 12 y 22% de las especies estimadas. Los factores de uniformidad indicaron que la comunidad está compuesta principalmente por especies raras y pocas especies dominantes. El inventario obtenido es confiable; no obstante, la curva de acumulación no alcanzó la asíntota, sugiriendo la necesidad de realizar estudios ecológicos adicionales empleando diversos protocolos para complementar nuestro conocimiento de estas arañas.

Palabras clave: Arañas cangrejo; Selva baja caducifolia; Ecología; Diversidad; Estacionalidad

Introduction

In general, most studies on spider communities in Mexico have analyzed spatial diversity patterns, with fewer studies focusing on seasonal diversity and abundance (Campuzano & Padilla-Ramírez, 2020; Corcuera et al., 2019; Jiménez et al., 2020, 2024; Menéndez-Acuña et al., 2023; Pérez-Hernández & Zaragoza-Caballero, 2016; Rodríguez-Rodríguez et al., 2015). The study of seasonal diversity variation and its associated processes is crucial for understanding ecosystem dynamics and establishing effective conservation strategies (Menéndez-Acuña et al., 2023; Pérez-Hernández & Zaragoza-Caballero, 2016). Moreover, understanding higher-taxon diversity can serve as a useful indicator of overall biodiversity (Williams & Gaston, 1994).

Basic ecological information is lacking for many megadiverse biological groups, including spiders (Colwell & Coddington, 1994). In Mexico, 2,345 spider species have been recorded, comprising 455 genera and 70 families (Ponce-Saavedra et al., 2023). Despite this high diversity, only 2 country-level inventories of Mexican spiders have been compiled (Hoffmann, 1976; Jiménez, 1996), and it has been estimated that only ~ 23% of the country's spider species are known (Francke, 2014; Ponce-Saavedra et al., 2023).

Spiders are suitable model organisms for ecological studies due to the ease of obtaining large samples for statistical analyses, their limited dispersal capacity, their presence in almost every ecosystem, and their high abundance (Colwell & Coddington, 1994; Halaj et al., 1998; Jiménez-Valverde & Hortal, 2003; Turnbull, 1973). However, when generating a species inventory for a megadiverse group, including spiders, encountering every species present at a certain locality takes considerable

effort due to the existence of rare species (Colwell & Coddington, 1994; Corcuera et al., 2019; Jiménez et al., 2024; Jiménez-Valverde & Hortal, 2003; Jiménez-Valverde & Lobo, 2004), the wide variety of collecting techniques needed, and the difficulty to systematize sampling protocols (Gotelli & Cowell, 2011; Wolda, 1988). Therefore, it is often beneficial to focus sampling efforts on smaller taxonomic groups (i.e., families, subfamilies, tribes), facilitating the standardization of protocols and the increased capacity to detect a higher proportion of the overall species number (Jiménez-Valverde & Hortal, 2003; Jiménez-Valverde & Lobo, 2004, 2005, 2007).

Crab spiders are an abundant and diverse group, being one of the dominant spider families in the community. They are an important link in the trophic chains as both predators and prey, and due to their proximity to the vegetation, these spiders are susceptible to changes in the environment (Benjamin, 2011; Benjamin et al., 2008; Clausen, 1986; Jocqué & Dippenaar-Schoeman, 2006; Lapp & Dondale, 2017; Morse, 2007). In addition, they are easy to identify in the field, making them a useful model for ecological studies and reliable regional faunistic inventories (Jiménez-Valverde & Lobo 2004, 2005, 2007).

In the Mexican state of Morelos, the first record of the family Thomisidae was made by F. O. Pickard-Cambridge (1895), who described *Synema madidum* from Cuernavaca. In the 128 years since then, only 5 species have been reported in 7 scientific papers (Pickard-Cambridge, 1895, 1900; Gertsch, 1953; Gertsch & Davis, 1940; Hoffmann, 1976; Nieto-Castañeda et al., 2014; Pickard-Cambridge, 1896). Similarly, ecological data for the family has been reported in only a few studies, which mostly focus on higher taxonomic levels, such as orders (Hernández-Silva, 2016; Menéndez-Acuña, 2017; Nieto-Castañeda et al., 2014; Rivas-Herrera, 2015).

To gather basic ecological data and initiate faunistic inventories for the family Thomisidae, we analyzed the community structure of crab spiders throughout an annual cycle. By comparing community structure across the rainy and dry seasons in a deciduous tropical forest, we aim to uncover temporal patterns in thomisid diversity and to contribute to the faunistic knowledge of these spiders in Morelos and Mexico more broadly.

Materials and methods

The study was carried out in the surroundings of San Andrés de la Cal, Tepoztlán, Morelos, in central Mexico (Fig. 1). The study area pertains to the protected areas Corredor Biológico Chichinautzin, and Parque Nacional El Tepozteco (Conanp, 1983; INEGI, 2017), located at 18°56'11" N, 99°06'46" W, with an average altitude of 1,507 m asl (Fig. 1). The climate is characterized as (A) Cw₂(W) ig, warm subhumid, the warmest of the subhumid climate types, with the presence of summer rains (García, 2004). The mean annual temperature is 20.5 °C, and the mean annual precipitation is 1,091.8 mm (INEGI, 2017;

Ruiz-Rivera, 2001). The dominant primary vegetation is deciduous tropical forest, characterized by trees under 12 meters in height and 2 marked seasons, a rainy season (June to October) and a dry season (November to May) (Balvanera & Maass, 2010; Miranda & Hernández, 1963; Trejo, 2010).

Two study sites were selected: “Derrame de Lava” (DL), located at 18°56'33.5" N, 99°06'57.4" W, and “Cerro de la Cal” (CC), located at 18°56'38" N, 99°06'31" W (Fig. 1). Both sites have specific geomorphological characteristics that generate differences in the composition of woody plants. Sixty species of woody plants are known across both sites. In DL 24 species are reported only for this site, with *Sapium macrocarpum* Müll. Arg. (Euphorbiaceae), *Ipomea pauciflora* M. Martens & Galeotti (Convolvulaceae), and *Quercus obtusata* Bonpl. (Fagaceae) being the predominant species. On the other hand, in CC 8 species were observed only at this site, with *S. macrocarpum* Müll. Arg., *Bursera fagaroides* (Kunth) Engl., *B. glabrifolia* (Kunth) Engl., and *B. copallifera* (DC.) Bullock (Burseraceae) predominates (Vergara-Torres et al., 2010).

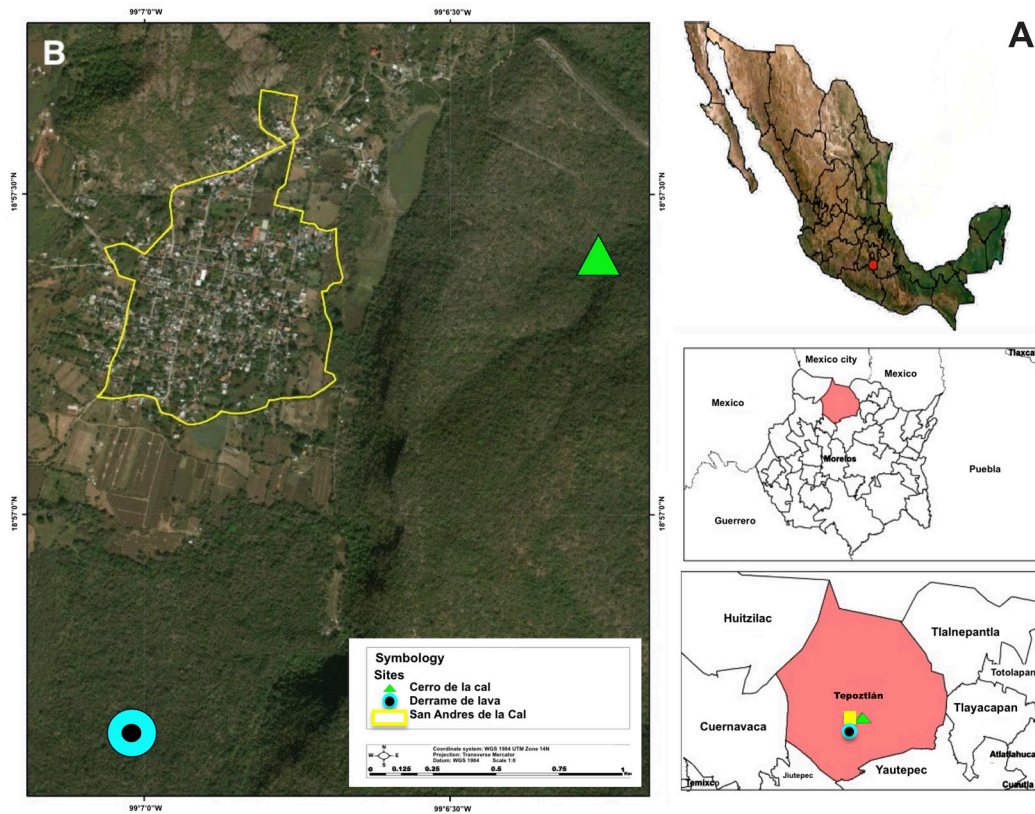


Figure 1. A, Map of Mexico, highlighting the state of Morelos; B, sampled localities in San Andrés de la Cal, Tepoztlán, Morelos, and the specific sites sampled.

Spiders of the family Thomisidae were collected over a one-year period, from September 2017 to August 2018. A systematic collection protocol was implemented, involving 2 days per month at each site and 5 collectors. Because these spiders are diurnal, collections were made over 6 daylight hours per day, from 10:00 to 16:00 h (Abraham, 1983), with an effort of 6 hours per person. We applied 3 manual sampling techniques to obtain the highest number of individuals and species: sweeping nets, beating sheets, and looking down (Jiménez-Valverde & Lobo, 2005). Transects were made *ad libitum* without repeating sampled sections in an area of approximately 2 km², with the purpose of including the largest possible area.

The collected spiders were placed in glass jars containing 96% ethanol and labeled with the corresponding data, including locality, date, geographical coordinates, altitude, and the collectors' names. Later, the spiders were identified at the Colección de Insectos de la Universidad de Morelos (CIUM) in the Centro de Investigación en Biodiversidad y Conservación (CIByC), Universidad Autónoma del Estado de Morelos (UAEM), Cuernavaca. Finally, the specimens were deposited at the Colección Nacional de Arácnidos (CNAN) of the Instituto de Biología, Universidad Nacional Autónoma de México (IB-UNAM), Mexico City.

Identifications were initially conducted at family and genus levels using the taxonomic keys from Ubick et al. (2017) and Lapp and Dondale (2017), respectively. Only adult specimens were considered for species-level identification, in order to account for primary sexual structures (male palps and female epigynum). Species-level identifications were carried out using specialized literature (Pickard-Cambridge, 1900; Gertsch, 1953; Gertsch & Davis, 1940; Jiménez, 1986, 1992; Pickard-Cambridge, 1896). Adult spiders that could not be determined to genus level were assigned as Indeterminate Genus: In. Gen., whereas those that could not be assigned to species level were considered as morphospecies to be included in the ecological analyses.

Species richness and abundance were quantified as the number of species and individuals, respectively. Alpha diversity was calculated using EstimateS v.9.1 (Colwell, 2013), following the concept of true diversity proposed by Jost (2006), with Hill's formula applied to q-values of 0, 1, and 2. Order 0 (⁰D) considers only species richness, order 1 (¹D) considers each species' proportional frequency without favoring rare or common species, and order 2 (²D) favors abundant species (Jost & González-Oreja, 2012). A dominance-diversity curve was plotted in Microsoft Excel to visually evaluate community structure. Additionally, evenness factors were calculated: $EF_{0,1}$ representing the proportion of common species in the community, $1 - EF_{0,1}$

representing the proportion of rare species, and $EF_{0,2}$ representing the proportion of dominant species (Jost, 2010). Monthly observations of richness, abundance, and diversity enabled us to assess the seasonal behavior of the family Thomisidae.

We then conducted a χ^2 test to assess the relationships between the abundance of adult and immature individuals and between male and female specimens, using R (R Core Team, 2024) and RStudio v.4.3.1 (RStudio Team, 2020). A species accumulation curve was constructed using the iNEXT online software (Chao et al., 2016) following the methodology of Chao et al. (2014) to visualize how the number of species accumulates with increasing sample size. Finally, to estimate the number of species at each site, we computed 4 non-parametric richness estimators: Chao 1, Chao 2, first-order Jackknife, and second-order Jackknife, using EstimateS v.9.1 (Colwell, 2013).

Results

A total of 16 species comprising 11 genera of crab spiders were recorded (Figs. 2-26, Table 1). All species captured represent new records for San Andrés de la Cal, and 9 species and 5 genera are new records for Morelos (Table 1). The genus with the highest richness was *Misumenoides* F. O. Pickard-Cambridge, 1904, with 4 species (26%), followed by *Tmarus* Simon, 1875, and *Mecaphesa* Simon, 1900, each with 2 species. Only 1 species was recorded for all other genera (Table 1).

Regarding seasonal richness, a marked seasonality was observed, with higher richness during the rainy season ($S = 14$). The highest richness was in July and September, with 10 species each (Fig. 26B). In contrast, the dry months showed lower richness ($S = 10$), with the lowest richness recorded in January and March, with only 1 species each (Fig. 26B). Eight species were recorded in both seasons, while 6 were found only in the rainy season and 2 only in the dry season (Table 1), showing seasonal differences in species composition. Of the 16 species recorded in this work, 31% were found only during 1 or 2 sampled months, while the dominant species was recorded in 9 of the 12 months (Table 1, Fig. 27).

A total of 839 individual spiders were collected, with 596 immatures and 243 adults (149 males and 94 females). The highest abundance was recorded in October ($N = 208$), with 113 immatures and 95 adults, whereas April had the lowest abundance ($N = 20$), with 16 immatures and 4 adults (Fig. 26A, Table 1). Statistical differences were found between the proportions of adults and immatures over the 12-month sampling period ($\chi^2 = 161.11$, f. g. = 11, $p < 0.0001$), as well as between females and males ($\chi^2 = 36.768$, f. g. = 10, $p < 0.0005$).

Table 1

Checklist and abundances (of adults) for the species in the Thomisidae family recorded from San Andrés de la Cal, Tepoztlán. °New genus record for Morelos. *New species record for Morelos.

Month species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
<i>Bucranium aff affinis</i> °	-	1	-	1	1	-	-	-	-	-	-	-	3
In. Gen.	-	-	-	-	-	-	13	12	1	1	-	1	28
In. Gen. 2	-	-	-	-	-	-	-	1	-	-	-	-	1
<i>Isaloides</i> sp. 1°	-	-	-	-	1	3	2	1	-	-	-	-	7
<i>Mecaphesa dubia</i> *	1	-	-	2	2	4	4	-	17	78	11	5	124
<i>Mecaphesa rothi</i> *	-	-	-	-	-	-	-	-	1	-	-	-	1
<i>Misumenoides annulipes</i> *	-	-	-	-	-	-	1	2	2	3	-	-	8
<i>Misumenoides formosipes</i> *	-	-	-	-	3	-	1	-	1	3	1	-	9
<i>Misumenoides quetzaltocatl</i> *	-	-	-	-	-	-	-	-	1	1	-	-	2
<i>Misumenoides</i> sp. 1	-	-	-	-	-	-	7	1	4	-	1	-	13
<i>Ozyptila</i> sp. 1°	-	1	-	-	-	-	-	-	-	-	-	-	1
<i>Parasynema cirripes</i>	-	-	-	-	-	2	-	3	1	-	-	-	6
<i>Synema lopezi</i> *	-	-	-	-	1	1	2	0	1	3	1	-	9
<i>Tmarus ehecattlocatl</i> *	-	-	-	-	4	5	2	-	1	4	3	1	20
<i>Tmarus vitusius</i> *	-	-	-	1	1	1	2	-	-	-	-	-	5
<i>Xysticus facetus</i>	-	-	-	-	-	5	1	-	-	-	-	-	6

Over the entire sampling period, the genus *Mecaphesa* had the highest abundance, with 226 individuals (Fig. 27). Among these, *Mecaphesa dubia* (Keyserling, 1880) (Figs. 17, 18) was the most abundant species, comprising 124 individuals. According to the evenness factors ($EF_{0.2} = 0.23$), *M. dubia*, “In. Gen.” and *Tmarus ehecattlocatl* Jiménez, 1992 (Figs. 12, 13) are dominant species in the community. On the other hand, 4 species had intermediate abundances (8-20 individuals) and can be considered common species ($EF_{0.1} = 0.41$), while 9 species are categorized as rare, with less than 7 individuals found ($1 - EF_{0.1} = 0.59$) (Fig. 27). Furthermore, 3 species were considered singletons, 2 species doubletons, 2 other species duplicates, and 5 species uniques (Table 1, Fig. 27).

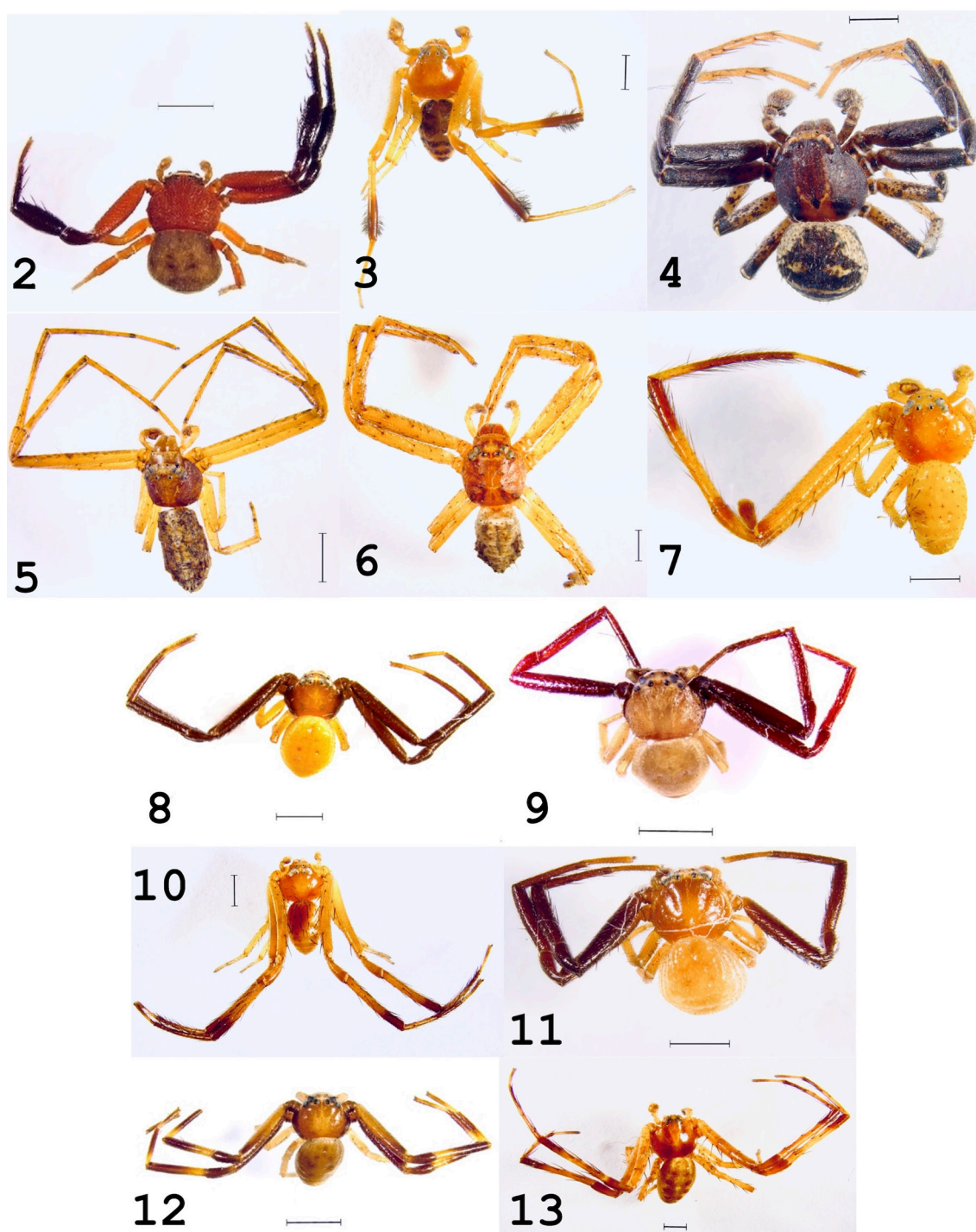
Regarding seasonal abundances, the rainy season showed the highest abundance ($N = 538$; 61%), with October having the highest ($N = 208$). In contrast, the dry season showed lower abundance ($N = 301$; 39%), with the lowest abundance in April ($N = 20$) (Fig. 26A, Table 1).

When only considering the abundance of adult specimens, most adults (79%) were recorded during rainy season (males = 119; females = 77), while only 21% of the total adult abundance was recorded in the dry season (males = 30; females = 17). Immature individuals

showed the same pattern, with 54% of the total immature abundance recorded in the rainy season and 46% in the dry season (Fig. 26A).

The evenness factors for the rainy season were $EF_{0.1} = 0.45$, $1 - EF_{0.1} = 0.55$, and $EF_{0.2} = 0.26$, meaning that 45% of the species can be considered as common, 26% as dominant species, and 55% as rare species. For the dry season, the evenness factors were $EF_{0.1} = 0.56$, $1 - EF_{0.1} = 0.44$, and $EF_{0.2} = 0.36$, meaning that 56% of the species are considered common species, 36% as dominant species, and 44% as rare species (Table 2). *Mecaphesa dubia* was the dominant species in both seasons, with 91 individuals in the rainy season and 24 in the dry season.

The diversity of the Thomisidae community, based on Hill numbers, was calculated as 16 effective species (^0D), 6.56 effective species equally abundant (^1D), and 3.66 effective species equally dominant (^2D) (Table 2). As for seasonal diversity, the rainy season yielded 14 effective species (^0D), with 6.3 effective species equally abundant (^1D), peaking at 6.6 effective species in July. Meanwhile, for ^2D the diversity was 3.7 effective dominant species with a peak diversity of 5.37 effective dominant species in June (Table 2). In contrast, the dry season yielded a diversity of 9 effective species (^0D), 5.08 effective species equally



Figures 2-13. Habitus, dorsal view of the male thomisid spider species recorded herein. 2) In. Gen; 3) *Parasynema cirripes*; 4) *Xysticus facetus*; 5) *Tmarus ehecatltoatl*; 6) *Tmarus vitusus*; 7) *Mecaphesa rothi*; 8) *Misumenoides formosipes*; 9) *Misumenoides* sp. 1; 10) *Mecaphesa dubia*; 11) *Misumenoides quetzaltocatl*; 12) *Misumenoides annulipes*; 13) *Isaloides* sp. 1.



Figures 14-25. Habitus, dorsal view of the female thomisid spider species recorded herein. 14) In. Gen; 15) *Isaloides* sp. 1; 16) *Parasynema cirripes*; 17) *Mecaphesa dubia*; 18) *Tmarus ehecaltlocatl*; 19) *Misumenoides formosipes*; 20) *Synema lopezi*; 21) *Tmarus vitus*; 22) *Xysticus facetus*; 23) *Misumenoides quetzaltocatl*; 24) *Ozyptila* sp. 1; 25) *Bucranium aff. affinis* (J).

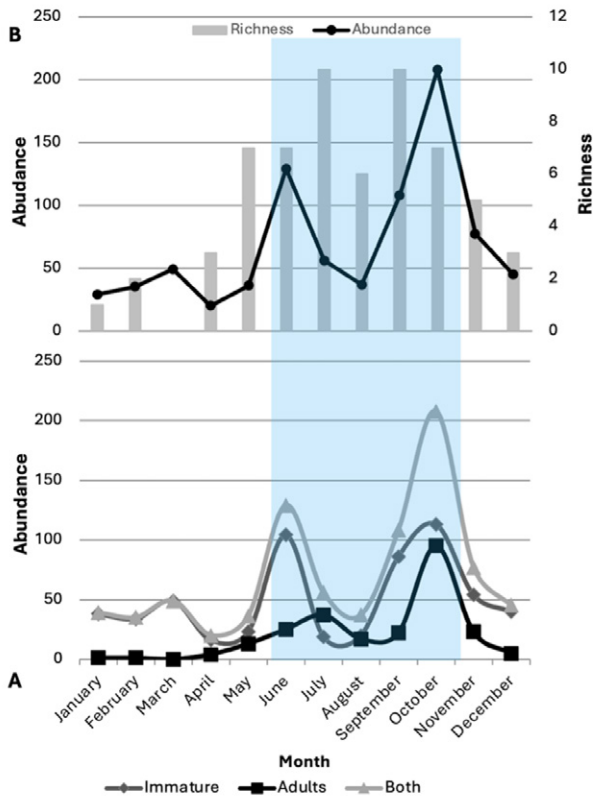


Figure 26. A, Abundances of thomisid spiders throughout the year; B, richness and total abundances across the annual cycle.

abundant (^1D), with a peak diversity of 5.91 effective species in May, and 3.26 effective dominant species (^2D) with a peak diversity of 5.12 effective dominant species in May (Table 2).

The species accumulation curve showed continuous growth without reaching an asymptote, indicating that the true number of species in the study area is greater than what we recorded (Fig. 28). According to the richness

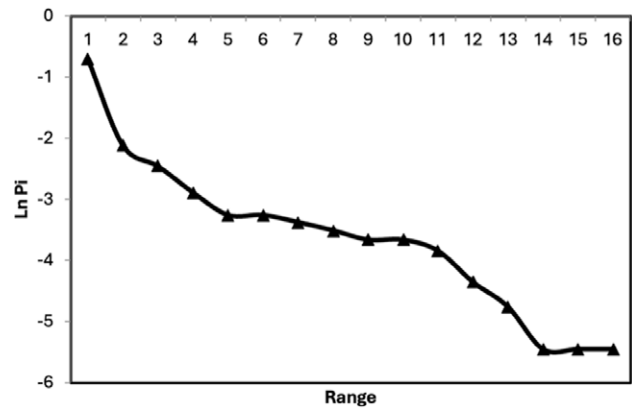


Figure 27. Dominance/diversity plot of spiders in the Thomisidae family collected in San Andrés de la Cal, Tepoztlán, Morelos.

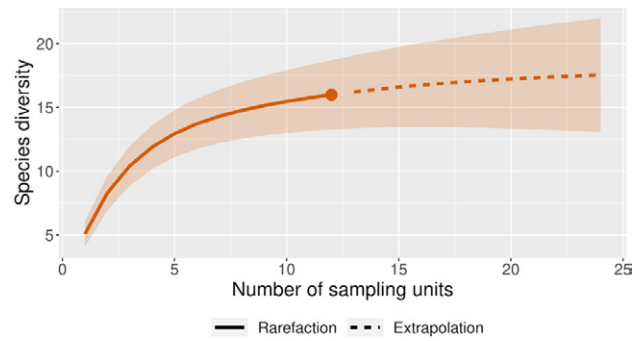


Figure 28. Accumulation curve of species in the Thomisidae family from the sampled locality.

Table 2

True diversity indices (^0D , ^1D , ^2D), richness (S), and abundances (A) for each month over 1 year, and summarized for the 2 seasons.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Dry season	Rainy season
S	1	2	-	3	7	7	10	6	10	7	5	3	16	9	14
A	1	2	-	4	13	22	35	20	24	86	18	9	234	47	187
^0D	1	2	-	3	7	7	10	6	10	7	5	3	16	9	14
^1D	1	2	-	2.83	5.91	5.93	6.66	3.56	5.99	2.12	2.85	1.98	6.56	5.08	6.29
^2D	1	2	-	2.66	5.12	5.37	4.84	2.5	3.89	1.45	2.07	1.58	3.66	3.26	3.66

Discussion

Due to the scarce taxonomic information on the spider family Thomisidae in Mexico, the lack of reference collections and specialists, it is not uncommon for faunistic inventories or ecological studies to report a high percentage of unknown or undescribed crab spider species, often with more than 80% of records identified only as morphospecies (Álvarez-Padilla et al., 2020; Argañaraz & Gleiser, 2017; Desales-Lara, 2014; González-Castillo et al., 2014; Maldonado-Carrizales et al., 2021; Nieto-Castañeda et al., 2014; Rivera-Quiroz et al., 2016; Rodríguez-Rodríguez et al., 2015). This project reported only 31% of crab spiders as morphospecies.

The records presented herein constitute 19% and 61% of the Thomisidae species and genera reported for the country, respectively (Cortez-Hernández, 2019; Desales-Lara et al., 2013; Durán-Barrón et al., 2009; González-Castillo et al., 2014; Jiménez et al., 2020; Rodríguez-Rodríguez et al., 2015). Currently, the spider family Thomisidae in Mexico comprises 18 genera and 83 species (World Spider Catalog, 2025). However, more than one-third of Mexican states have no records, or only a few (Pilo-García, 2022). Moreover, with these results, Morelos now has the fifth highest number of thomisid species in Mexico (16 species), followed by Veracruz (19 species), Baja California (19 species), Chihuahua (19 species), and Chiapas (16 species) (Pilo-García, 2022; World Spider Catalog, 2025). The results presented herein suggest that Thomisidae in Morelos may exhibit higher diversity if appropriate protocols are implemented. Currently, Thomisidae is the fourth most diverse spider family in Morelos in terms of species richness (16 species).

Previous studies in Mexican deciduous tropical forests have recorded the genera *Mecaphesa* (Jiménez et al., 2020; Menéndez-Acuña, 2017) and *Synema* Simon, 1864 (Cortez-Hernández, 2019) as the most diverse thomisid genera, but herein we found *Misumenoides* to have the highest species richness, followed by *Mecaphesa* and *Tmarus*. Of the 7 *Misumenoides* species recorded in Mexico, we report 4 from Morelos. Of the 9 *Mecaphesa* species and 5 *Tmarus* species reported in Mexico, we recorded 2 species of each in Morelos.

We found that Thomisidae individuals are present year-round and are predominantly immature, a common pattern in Araneae (Hernández-Silva, 2016; Jiménez et al., 2020; Llinas-Gutiérrez & Jiménez, 2004; Lopes-Rodrigues et al., 2023; Maldonado-Carrizales et al., 2021; Menéndez-Acuña et al., 2023). Llinas-Gutiérrez and Jiménez (2004) found that *Misumenops dubius* (now *Mecaphesa dubia*) was a very abundant and dominant

species in tropical deciduous forests of Baja California Sur, consistent with our results, which found *M. dubia* to be the dominant species in the sampled communities, present almost year-round.

An interesting observation from this study is the fact that the abundance of males was statistically higher than that of adult females. This is uncommon among spiders, with most studies recording a higher number of females than males (Ávalos et al., 2007; Desales-Lara et al., 2013; Menéndez-Acuña et al., 2023; Nadal et al., 2018; Orozco-Gil & Desales-Lara, 2021; Rodríguez-Rodríguez et al., 2015). However, this pattern has been previously recorded in the family Thomisidae (Hernández-Silva, 2016; Maldonado-Carrizales et al., 2021; Nieto-Castañeda et al., 2014; Piña-Rodríguez et al., 2015; Rivas-Herrera, 2015). This discrepancy in sexes could align to the Gravity Hypothesis, which posits that in some spiders there is an extreme sexual dimorphism in size, especially in species acting as sit-and-wait predators, such as Thomisidae. This allows smaller males to employ more effective locomotion strategies, such as ballooning and bridging, enabling them to travel and cover larger areas. In this way, adult males are more active in searching for reproductive females (Corcobado et al., 2010; Hormiga et al., 2000). Corcobado and collaborators tested this hypothesis in 3 Thomisidae species (*Synema globosum*, *Thomisus onustus*, and *Misumena vatia*) and observed the aforementioned pattern, noting that it is common in Thomisidae, and was the one presented by this family in the study area.

The marked seasonality observed in the abundance of thomisids in our study area, with greater abundance in the rainy than in the dry season, aligns with that of previous thomisid studies in other parts of the world with abundances during the rainy season often being twice as high as during the dry season (Cardoso et al., 2007), including in southern Morelos (Hernández-Silva, 2016). In contrast to the latter study, however, we documented multiple adults during the dry season, which could indicate local differences in the seasonality of adults or differences in the thoroughness of sampling across studies. This demonstrates the importance of complete sampling over the entire year to avoid underestimating community structure. On the other hand, it has been previously recorded that the main prey for thomisids, like butterflies and beetles, show the same pattern; this could benefit the abundance of crab spiders as food becomes readily available, enabling the development of a greater number of individuals (Corona-López et al., 2017; Luna-Reyes et al., 2008; Martínez-Hernández et al., 2019, 2022; Rosas-Echeverría et al., 2019).

Another notable observation regarding differences in composition and abundance between the 2 seasons is that rare species were more abundant in the rainy season, whereas more common species were recorded in the dry season; consequently, some species are less active in the dry season. This could be due to the availability of resources (prey), which allows more species to proliferate during the rainy season, while the limited resources during the dry season are accessible to fewer species (Arango et al., 2000; Cardoso et al., 2007; Connell & Orias, 1964; Lopes-Rodrigues et al., 2023; Wolda, 1988). This pattern has been similarly observed in other species of the family in the tropical region (i.e., *Runcinioides argenteus* Mello-Leitão, 1929), in which an increase in spider populations apparently coincides with the blooming season and peaks in potential prey during the rainy season period (Quevedo-Romero & Vasconcellos-Neto, 2003).

Most species recorded in spider inventories are rare (singletons or doubletons), making it difficult for the cumulative curve to approach the asymptote. While it is generally accepted in the literature that the highest proportion of species in the order Araneae are rare, few works have statistically evaluated this notion (Coddington et al., 1996, 2009; García-García et al., 2023; Maya-Morales et al., 2012; Reyes-González et al., 2024; Samu & Lövei, 1995; Sørensen et al., 2002). By calculating evenness factors for the community, we assessed the relative abundance of species and found evidence that the community is predominantly composed of rare species (Jost, 2010). In tropical regions, the percentage of spiders recorded as singletons ranges from 13–63%, with an average of 37% (Esquivel-Gómez et al., 2016; Menéndez-Acuña et al., 2023; Silva & Coddington, 1996; Sørensen, 2002). In the present work, the proportion of singletons was 19%, and more than half of the recorded species are considered rare.

According to the 3 diversity orders estimated for the community, the maximum expected diversity for the locality was not obtained. Although the rainy season showed greater diversity than the dry season, sampling during this period was still below the maximum diversity (0D), possibly because some species are less active, resulting in more even abundance distributions. This pattern of greater “artificial” diversity in the dry season, with lower richness and abundance, has been previously reported in other spider groups of tropical deciduous forests (Menéndez-Acuña et al., 2023).

In conclusion, the family Thomisidae in Morelos is more diverse than previously considered, highlighting the importance of generating reliable regional faunistic inventories. Although recording all estimated spider

species is difficult, we show that using at least 3 techniques with monthly sampling is sufficient to obtain a reliable inventory of spiders in the family Thomisidae, even in the diverse habitat of deciduous tropical forests. However, we recommend using alternative techniques whenever possible to approach the asymptote. A seasonal pattern was observed in these spiders, with the highest levels of diversity, richness, and abundance occurring during the rainy season (⁰D). However, combining sampling efforts across both the rainy and dry seasons is recommended to obtain accurate and comparable data. We consider spiders of the family Thomisidae to be good ecological models because of their close association with vegetative strata and their predatory traits. Further studies on this family from other localities, incorporating diverse sampling techniques, will help broaden our understanding of their community structure and spatial and temporal variation, which are necessary for identifying related ecosystem processes and dynamics and for establishing conservation strategies.

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