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REVISIÓN SISTEMÁTICA DEL GÉNERO DE ARAÑAS *IXCHELA* HUBER, 2000 (ARANEAE: PHOLCIDAE)

TESIS

QUE PARA OPTAR POR EL GRADO DE:

DOCTOR EN CIENCIAS

PRESENTA:

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P r e s e n t e

Me permito informar a usted que en la reunión ordinaria del Comité Académico del Posgrado en Ciencias Biológicas, celebrada el día 3 de junio de 2013, se aprobó el siguiente jurado para el examen de grado de **DOCTOR EN CIENCIAS** del alumno **VALDEZ MONDRAGÓN ALEJANDRO** con número de cuenta **400007623** con la tesis titulada: **"Revisión sistemática del género de arañas Ixchela Huber, 2000 (Araneae: Pholcidae)"**, realizada bajo la dirección del **DR. OSCAR FEDERICO FRANCKE BALLVÉ:**

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Í N D I C E

RESUMEN

Se realizó la revisión sistemática del género de arañas *Ixchela* Huber, 2000 (Araneae: Pholcidae) trabajando en dos secciones, una parte taxonómica y una segunda investigando la filogenia del género con base a evidencia morfológica y evidencia molecular. La revisión taxonómica consistió en la redescripción de las cinco especies previamente descritas para el género antes de este trabajo, describiendo por primera vez los machos de *Ixchela placida* e *Ixchela simoni*. Se recolectaron especimenes adicionales de las especies previamente descritas, además de especimenes pertenecientes a 15 especies nuevas para la ciencia, 14 de México y una especie nueva de Honduras. Se describen 10 nuevas especies: *Ixchela mixe* sp. nov., *Ixchela huberi* sp. nov., *Ixchela juarezi* sp. nov., *Ixchela grix* sp. nov., *Ixchela taxco* sp. nov., *Ixchela franckei* sp. nov., *Ixchela tzotzil* sp. nov., *Ixchela santibanezi* sp. nov., *Ixchela huasteca* sp. nov., e *Ixchela viquezi* sp. nov.; y cinco especies descritas en el segundo manuscrito: *Ixchela azteca* sp. nov., *Ixchela jalisco* sp. nov., *Ixchela mendozai* sp. nov., *Ixchela purepecha* sp. nov. e *Ixchela tlayuda* sp. nov. Además, se encontró nueva información taxonómica y nuevos registros de distribución para las especies y se hizo una clave taxonómica para la identificación de machos y hembras de las especies del género. Con respecto al estudio filogenético, se puso a prueba la monofilia del género *Ixchela*, estableciendo sus relaciones filogenéticas internas con datos morfológicos y moleculares. Para ello, se usaron dos genes mitocondriales, *citocromo c oxidasa subunidad 1* (CO1) y 16S rRNA. Los análisis filogenéticos se llevaron a cabo utilizando máxima parsimonia (MP) e inferencia Bayesiana (IB). En los análisis de MP se utilizó el pesaje implícito de caracteres, con siete valores de concavidad (*K*). El análisis morfológico con una matriz de 40 caracteres recobró cinco árboles igualmente parsimoniosos, soportando la monofilia del género con ocho sinapomorfías. Tanto los análisis filogenéticos con MP e IB para CO1 (506 caracteres) y MP para 16S (379 caracteres) soportan la monofilia del género. Los análisis con MP e IB tanto para COI+16S (885 caracteres) como de evidencia total (morfología+CO1+16S; 925 caracteres) soportan la monofilia de *Ixchela*. Las hipótesis encontradas con MP y análisis Bayesiano recuperaron la mayor parte las relaciones internas del genero *Ixchela*; sin embargo, la hipótesis obtenida con evidencia morfológica difirió considerablemente de las topologías obtenidas con evidencia molecular, aunque los análisis con CO1, CO1+16S, y evidencia total obtuvieron una mejor resolución interna entre las especies. Con respecto a la evidencia proporcionada por ambos genes, las topologías obtenidas con MP e IB usando COI obtuvieron mejor resolución interna que las topologías encontradas con el gen 16S, esto debido a que el fragmento de CO1 tuvo más caracteres informativos que 16S. Finalmente, los análisis con CO1, CO1+16S y evidencia total encontraron dos clados dentro de *Ixchela*, siendo *Ixchela furcula* el grupo hermano de *Ixchela*. El clado 1 esta conformado por cinco especies: *I. mixe, I. franckei, I. viquezi*, *I. santibanezi* e *I. pecki*, biogeográficamente con una distribución en bosques templados de Chiapas, Oaxaca y hacia América Central, conocido como Componente biótico Mesoamericano; aunque *I. mixe* e *I. franckei* tienen una distribución biogeográfica hacia el Componente biótico Mexicano de Montaña. El clado 2 esta conformado por 14 especies: *I. abernathyi, I. azteca, I. grix, I. huasteca, I. huberi, I. jalisco, I. juarezi, I. mendozai, I. placida, I. purepecha, I. taxco, I. tlayuda, I. tzotzil,* e *I. simoni*, el cual biogeográficamente esta distribuído en bosques templados de la Sierra madre Occidental y Oriental, Eje Neovolcánico, cuenca del Balsas y Sierra Madre del Sur, conocido en su totalidad como el Componente biótico Mexicano de Montaña,

aunque *I. tzotzil* tiene una distribución biogeográfica hacia el Componente biótico Mesoamericano.

ABSTRACT

A systematic revision of spider genus *Ixchela* Huber, 2000 (Araneae: Pholcidae) was done working in two sections, the first section on the taxonomic aspects, and the second section researching the phylogeny of the genus based on morphological and molecular evidence. The taxonomic revision initially contemplated the redescription of the five previous described species for the genus before this work, describing the males of *Ixchela placida* and *Ixchela simoni* for the first time. Additional specimens of the previously described species and specimens of 15 new species for science were collected, 14 from Mexico and one from Honduras. Ten new species were described in the first paper: *Ixchela mixe* new species, *Ixchela huberi* new species, *Ixchela juarezi* new species, *Ixchela grix* new species, *Ixchela taxco* new species, *Ixchela franckei* new species, *Ixchela tzotzil* new species, *Ixchela santibanezi* new species, *Ixchela huasteca* new species, and *Ixchela viquezi* new species; and five species described in the second paper: *Ixchela azteca* new species, *Ixchela jalisco* new species, *Ixchela mendozai* new species, *Ixchela purepecha* new species, and *Ixchela tlayuda* new species. In addition, new taxonomic information and new distribution records of the species were found and a taxonomic identification keys for males and females of the species of the genus were done. In relation with the phylogenetic analyses, the monophyly of the genus *Ixchela* was tested, establishing its internal phylogenetic relationships with morphological and molecular data. Two mitochondrial genes were used, *cytochrome c oxidase subunit 1* (CO1) and 16S rRNA. The phylogenetic analyses were done using maximum parsimony (MP) and Bayesian inference analyses (BI). In the MP analyses the implied weighting of characters was used, with seven concavity values (*K*). The morphological analysis with 40 characters found five most parsimonious trees, supporting the monophyly of the genus with eight synaphomorphies. With molecular data, the phylogenetic analyses with MP and BI for COI (506 characters), and MP with 16S (379 characters) support the monophyly of the genus. The analyses with MP and BI for COI+16S (885 characters) and for total evidence: (morphology+COI+16S; 925 characters) support the monophyly of *Ixchela*. The hypothesis found under MP and BI recovered most of the internal relationships of the genus *Ixchela*, however, the hypothesis found with morphological evidence was considerably different from the topologies found with molecular evidence, although the analyses with CO1, CO1+16S, and total evidence had a better internal resolution among the species. In relation with the evidence given with both genes, the topologies found with MP and BI using CO1 had better internal phylogenetic resolution than the topologies found using the gene 16S, because the fragment of CO1 had more informative characters than 16S. Finally, the analyses with CO1, CO1+16S and total evidence found two clades within *Ixchela*, being *Ixchela furcula* the sister group of *Ixchela*. The clade 1 is composed by five species: *I. mixe, I. franckei, I. viquezi*, *I. santibanezi*, and *I. pecki*, biogeographically with a distribution in template forest of Chiapas, Oaxaca and toward Central America, known as the Mesoamerican biotic component; although *I. mixe* and *I. franckei* have a biogeographical distribution toward the Mexican Mountain biotic component. The clade two is composed by 14 species: *I. abernathyi, I. azteca, I. grix, I. huasteca, I. huberi, I. jalisco, I. juarezi, I. mendozai, I. placida, I. purepecha, I. taxco, I. tlayuda, I. tzotzil*, and *I. simoni*, which biogeographically is distributed in template forest of the Sierra Madre

del Sur, known as the Mexican Mountain biotic component, although *I. tzotzil* has a biogeographical distribution toward the Mesoamerican biotic component.

1. INTRODUCCIÓN

La familia de arañas Pholcidae C. L. Koch, 1851 está conformada por un total de 84 géneros y 1084 especies (Platnick, 2013). Entre las arañas, las familia Pholcidae resulta interesante en diversos aspectos; en primer lugar, una serie de publicaciones acerca de la morfología funcional de los órganos copulatorios han generado datos únicos no solo en arañas, sino probablemente en los artrópodos en general (Huber, 1994, 1995, 1996 a,b, 1997 a,b, 1998a, 2002; Huber y Eberhard, 1997; Uhl *et al.*, 1995). En segundo lugar, en lugares tropicales alrededor del mundo son de los grupos de arañas más diversos, incluso en ciertos lugares se encuentran entre las familias de arañas tejedoras más abundantes; teniendo además un alto número de especies sinantrópicas (Huber, 2000; Bruvo-Madaric *et al.*, 2005). La familia Pholcidae además es la que tiene el mayor número de especies asociadas a cuevas, teniendo especies que pueden ser consideradas como troglobias por llevar de manera total su ciclo de vida dentro de las cuevas; o troglófilas, por tener la facultad de llevar parte de su ciclo de vida dentro y fuera de las cuevas, sin depender totalmente de ellas. Existe diversidad aún desconocida de la familia Pholcidae, principalmente en los trópicos del Nuevo Mundo (Bruvo-Madaric *et al.*, 2005; Huber, 2000, 2003). Por ejemplo, en un estudio al norte de Perú, Silva (1996) reportó más de dos docenas de morfoespecies en un área de bosque restringido, siendo que solamente cuatro especies habían sido reportadas para todo Perú (Huber, 2000). Gertsch (1982) describió 44 especies nuevas de *Anopsicus* Chamberlin e Ivie, 1938 en una región donde sólo se conocían 19 especies. Huber (1998b) describió 10 especies nuevas de *Modisimus* Simon, 1893 en Costa Rica, donde solamente una especie había sido registrada. Valdez-Mondragón (2010) en una revisión taxonómica de *Physocyclus* Simon, 1893 describe 13 especies nuevas del género para México donde previamente se conocían 15 especies. De esta manera, en regiones del Nuevo Mundo como el caso de México y Brasil, donde la descripción de especies ha sido pobre, es necesaria la redescripción de especies y la descripción de especies nuevas (Huber, 2000). La situación en el Viejo Mundo no es diferente, Deeleman-Reinhold (1986) registra 28 especies sin describir de *Belisiana* Thorell del sureste de Asia. Para este género, Huber (2005) registra 64 especies descritas, lo que hace a *Belisiana* el tercer género más diverso de la familia Pholcidae junto con *Anopsicus*, después de *Pholcus* Walckenaer, 1805 y *Metagonia* Simon, 1893. En un estudio de estimación de la riqueza de especies de arañas en un bosque de la montaña Uzungwa, en el Este de África, realizado por un grupo de zoólogos de Dinamarca, Tanzania y Estados Unidos (Sorensen *et al.*, 2002; Sorensen, 2003); las arañas más abundantes fueron de la familia Pholcidae, de un total de 14329 especímenes adultos de todas las arañas registradas, 4319 fueron de la familia Pholcidae (Huber, 2003).

Esta gran diversidad de la familia Pholcidae, ha generado mucha confusión taxonómica de algunos grupos. Ejemplo típico es el caso del género *Coryssocnemis* Simon, 1893 dividido en seis géneros (más algunas especies *inserta sedis*) (Huber, 2000). Una práctica común es el asignamiento arbitrario de especies a ciertos géneros, como en los casos donde hembras y machos de la misma especie son asignados a géneros diferentes [ej. *Coryssocnemis togata* (Keyserling, 1891) y *Blechroscelis coerulea* (Keyserling, 1891)] (Huber, 2000). El caso más extremo quizá sea el creado por Mello-Leitão (1947), donde una especie es descrita en dos diferentes géneros y con tres nombres específicos diferentes, y que todas éstas son sinonimias de una especie que el mismo autor describió 17 años antes [*Blechroscelis aurantiacus* Mello-Leitão, 1930 (ahora *Mesabolivar* González-Sponga, 1998)] (Huber, 2000). González-Sponga ostenta el mayor número de especies transferidas y de especies sinonimizadas dentro de la familia Pholcidae. Esta problemática, se debe en gran parte a que hay un número extremadamente grande de especies que son difíciles de identificar (incluso a nivel genérico) con la literatura existente (Brignoli, 1981). Sin embargo, la revisión genérica de Huber (2000) ha aportado significativamente al conocimiento de nuevos géneros y especies del Nuevo Mundo, facilitando su identificación.

La primera clasificación de la familia Pholcidae fue realizada por Simon (1893), la cual siguió utilizándose hasta las nuevas clasificaciones de Petrunkevitch (1928, 1929) y Mello-Leitão (1946) donde solo hacen cambios menores sin discutir la evidencia de dichos cambios, los cuales complicaron aún más la clasificación existente. La revisión más completa a nivel genérico fue realizada por Huber (2000), donde realizó además el primer análisis filogenético en la familia Pholcidae, utilizando caracteres morfológicos. Grandes avances respecto a las relaciones filogenéticas de la familia ha aportado el trabajo de Bruvo-Madaric *et al.* (2005), donde utilizan por vez primera evidencia combinada morfológica y molecular para establecer hipótesis filogenéticas entre los géneros; sin embargo, existen varias contradicciones e inconsistencias al comparar los resultados de ambas evidencias de forma separada. Astrin *et al.* (2006, 2007) evaluaron dos marcadores moleculares para la identificación de especies.

La familia Pholcidae es un grupo monofilético de acuerdo con la filogenia realizada por Huber (2000). En la familia previamente se reconocian los siguientes clados: “ninetines”, “pholcines” (*Metagonia* Simon, 1893 y el grupo *Pholcus* sensu Huber), “holocnemines” (grupo *Holocnemus* sensu Timm, *Artema* Walckenaer, 1837, *Physocyclus* Simon, 1893, y *Priscula* Simon, 1983) y el clado del “Nuevo Mundo”. Actualmente, estos clados conforman las cinco subfamilias de la familia Pholcidae: Ninetinae, Arteminae, Modisiminae, Smeringopinae y Pholcinae (Huber, 2011). El género *Ixchela* se encuentra dentro de las subfamilia Modisiminae, presentando las siguientes sinapomorfías con los otros 32 géneros de la subfamilia: 1) órgano tarsal expuesto, 2) coxa del pedipalpo del macho con apófisis retrolateral, 2) gonoporo del macho sin espigots epiandrus, 3) espineretas laterales anteriores con solo una glándula piriforme en cada espigot, y 4) distancia grande entre ocelos medios posteriores y ocelos laterales anteriores. Este género se asemeja a *Aymaria* Huber, 2000 de manera general en la forma del pedipalpo del macho, pero no hay sinapomorfías que liguen a estos géneros o que vinculen a *Ixchela* con un grupo hermano (Huber, 2000). *Ixchela* se distingue de otros géneros por la presencia de una apófisis redondeada prolateroventral, localizada en el bulbo del pedipalpo del macho, lo cual aparentemente sustenta su monofilia. También es característica la forma casi idéntica del pedipalpo del macho en todas las especies (Huber 1998, 2000). Las cinco especies de *Ixchela* estaban previamente incluidas en el género *Corysoccnemis* Simon, 1893.

El género *Ixchela* Huber, 2000 es endémico para México y Centroamérica. Previamente a este estudio era un género conocido en su mayor parte por recolectas individuales y por ende se desconocía la variación intraespecífica de la mayor parte de sus especies. De manera inicial, Huber (2000) erigió el género basado en cinco especies descritas: *Ixchela abernathyi* (Gertsch, 1971), *Ixchela furcula* (F. O. Pickard-Cambridge, 1902), *Ixchela pecki* (Gertsch, 1971), *Ixchela placida* (Gertsch, 1971) e *Ixchela simoni* (O. Pickard-Cambridge, 1898).

El género *Ixchela* está conformado por arañas grandes dentro de la familia, usualmente entre 6-9 mm. El dimorfismo sexual esta poco marcado. Quelíceros del macho con un par de apófisis frontales en parte distal [*Ixchela furcula, Ixchela pecki*], o protuberancias redondeadas basales [*Ixchela simoni*], o ambas [*Ixchela abernathyi*] diferentes por ejemplo a *Physocyclus* Simon, 1893 donde son laterales (Huber, 2000; Valdez-Mondragón, 2010). Las arañas pertenecientes a este género se les encuentra comúnmente dentro de cuevas y bajo troncos huecos húmedos en suelos de bosque de pino y encino. Algunas de las especies del género (ej. *I. furcula* y *I. simoni*), supuestamente presentaban distribuciones geográficas amplias y considerable variación intraespecífica, sobre todo en estructuras sexuales, lo cual no se había analizado hasta el presente trabajo. En especies como *Ciboneya antraia* Huber y Pérez, 2001, se ha demostrado que la genitalia de las hembras presenta casos de dimorfismo (Huber y Pérez, 2001a, b). A pesar de esto, la taxonomía alfa en arañas está determinada principalmente por las estructuras sexuales (Huber, 2004), ya que estas presentan poca variación intraespecífica pero conspicua variación interespecífica (Eberhard, 1985; Eberhard *et al.*, 1998), siendo caracteres que se consideran robustos para la identificación a nivel de especie (Astrin *et al.*, 2006). Previamente a este estudio, algunas de las especies de *Ixchela* estaban descritas solamente con base en hembras, incluyendo a la descripción original de la especie tipo, *Ixchela furcula* (F. O. Pickard-Cambdridge, 1902).

Debido a lo anterior, la presente tesis doctoral tuvo como objetivos: 1) hacer la revisión taxonómica del género, incluyendo redescripciones de las especies del género con descripciones incompletas y describiendo especies nuevas; 2) realizar una clave de identificación de las especies que componen este género; 3) llevar a cabo un análisis filogenético del género utilizando caracteres morfológicos y moleculares (secuencias de los genes CO1 y 16S) para establecer las relaciones filogenéticas entre las especies del género; 4) corroborar con base en los marcadores moleculares 16S y COI su utilidad en la delimitación de especies previamente basada en caracteres de estructuras copulatorias: pedipalpos en machos y epiginios en hembras; y 5) estudiar la variación interespecífica e intraespecífica con evidencia morfológica para probar la identificación y delimitación precisa de las especies.

2. CAPITULO I

ARTICULO REQUISITO

"Taxonomic revision of the spider genus *Ixchela* Huber, 2000 (Araneae: Pholcidae), with description of ten new species from Mexico and Central America"

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Taxonomic revision of the spider genus *Ixchela* Huber, 2000 (Araneae: Pholcidae), with description of ten new species from Mexico and Central America

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Abstract

A taxonomic revision of the genus *Ixchela* Huber, 2000 is presented. The previously described five species are redescribed with new taxonomic information and new distribution records. The males of *Ixchela placida* (Gertsch, 1971) and *Ixchela simoni* (O. Pickard-Cambridge, 1898) are described for the first time. Ten new species are described, nine from Mexico and one from Honduras: *Ixchela mixe* new species, *Ixchela huberi* new species, *Ixchela juarezi* new species, *Ixchela grix* new species, *Ixchela taxco* new species, *Ixchela franckei* new species, *Ixchela tzotzil* new species, *Ixchela santibanezi* new species, *Ixchela huasteca* new species, and *Ixchela viquezi* new species. Identification keys for males and females are presented.

Key words: Pholcidae, *Ixchela*, taxonomy, identification keys

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Resumen

Se realizó la revisión taxonómica del género *Ixchela* Huber, 2000. Las cinco especies previamente descritas son redescritas con nueva información taxonómica y nuevos registros de distribución. Los machos de *Ixchela placida* (Gertsch, 1971) e *Ixchela simoni* (O. Pickard-Cambridge, 1898) son descritos por primera vez. Se describen 10 especies nuevas, nueve de México y una de Honduras: *Ixchela mixe* sp. nov., *Ixchela huberi* sp. nov., *Ixchela juarezi* sp. nov., *Ixchela grix* sp. nov., *Ixchela taxco* sp. nov., *Ixchela franckei* sp. nov., *Ixchela tzotzil* sp. nov., *Ixchela santibanezi* sp. nov., *Ixchela huasteca* sp. nov., e *Ixchela viquezi* sp. nov. Claves de identificación para machos y hembras son presentadas.

Palabras clave: Pholcidae, *Ixchela*, taxonomia, claves taxonómicas

Introduction

The spider family Pholcidae is currently composed of 90 genera and 1288 species (Platnick 2012). Pholcids are among the most diverse and abundant web-building spiders around the world, principally in tropical and subtropical forests, with a high number of synanthropic species, plus from areas and habitats that are severely threatened by human impact (Huber 2000, 2011b). There are many examples of the diversity and abundance of pholcid spiders; for example in a study to estimate species richness of spiders in a mountain forest of Uzungwa in East Africa (Sorensen *et al.* 2002, Sorensen 2003), 4319 of a total of 14329 adult specimens of all spiders recorded were pholcids (Huber 2003). In another faunistic study in northern Peru, Silva (1996) reported over two dozen morphospecies of pholcids from a restricted rainforest area, whereas previously only four species were recorded from all of Peru. Gertsch (1982) described 44 new species of *Anopsicus* Chamberlin and Ivie, 1938 across the North, Central America and Caribbean regions, whereas only 19 were previously known. Huber (1998b) described 10 new species of *Modisimus* Simon, 1893 in Costa Rica, where only one was previously recorded). Huber (2011b) reports 254 species to the genus *Pholcus* which is the genus with the highest diversity in the family. Huber and Rheims (2011) described from Brazil 39 species (22 new species) from the Atlantic Forest. Pholcidae is one of the spider families with the highest number of species associated to caves, including some clearly troglomorphic or troglophiles species (Schiner 1854, Racovitza 1907), that can live or not in the caves. In Mexico, the family Pholcidae has the highest number of species associated to caves, including nine genera and 107 species, with 19 of those being highly troglomorphic species (Reddell 1981, Hoffmann 2003). The pholcids besides, in caves of tropical and subtropical forest are one of the spider families with highest abundances; for example Valdez-Mondragón (2006) in a study of the diversity and richness of spiders from Juxtlahuaca caves in Guerrero, Mexico; from both the dry and rainy seasons, found that the pholcid spider *Physocyclus bicornis* Gertsch, 1971 was the most abundant with a total of 1380 recorded specimens.

The diversity of pholcids is expected to by high, with many still unknown, mainly in the tropics and subtropics in the New World (Huber 2000). This is certainly the case of Mexico, with a high diversity of pholcid spiders expected, and apparently just a small percentage currently known: with 13 genera and 152 species of the five subfamilies of Pholcidae (Huber 2011a). Although there were several taxonomic contributions made by Gertsch (1971, 1973, 1982, 1986), Gertsch and Davis (1937, 1942), Gertsch and Mulaik (1940), Slowik (2009), Valdez-Mondragón and Francke (2009), and Valdez-Mondragón (2010) on Mexican pholcids, more intensive field work in tropical and subtropical forests in Mexico is still necessary, principally for additional sampling of poorly known and/or poorly collected genera for the redescription and description of new species. For example the genera poorly known as *Chisosa* Huber, 2000; *Pholcophora* Banks, 1896; *Tolteca* Huber, 2000; with one, three and one described species respectively. Besides, the re-examination of existing biological collections is very important because there remain many undetermined specimens of Mexican pholcids deposited in some important collections, such as The American Museum of Natural History, New York, U. S. A.; The Field Museum of Natural History, Chicago, U. S. A.; and The Colección Nacional de Arácnidos, Instituto de Biología, Universidad Nacional Autónoma de México, Mexico.

The genus *Ixchela* Huber, 2000 is until now poorly known, and is composed of relatively large pholcid spiders with a distribution in Mexico and Central America. Prior to this work, the genus had been composed of just five species: *Ixchela abernathyi* (Gertsch, 1971), *Ixchela furcula* (F. O. Pickard-Cambridge, 1902), *Ixchela pecki* (Gertsch, 1971), *Ixchela placida* (Gertsch, 1971) and *Ixchela simoni* (O. Pickard-Cambridge, 1898). These species were originally placed in the genus *Coryssocnemis* Simon, 1893, but Huber (2000) transferred these five species into the new genus *Ixchela*, based on the prolateroventral protrusion on the genital bulb of the male (Huber, 1998a). Huber (2000) mentions that the genus *Ixchela* shares several apomorphies with other New World genera. In overall shape it resembles *Aymaria*, a South American genus; however, this resemblance is based on similarity and not by synapomorphies that would link both genera or link *Ixchela* with another sister group. The present contribution is the taxonomic revision of genus *Ixchela*, with redescription of the five previously known species, and the description of ten new species, each with new taxonomic data and distribution records.

FIGURES 1–12. Living specimens of the genus *Ixchela* Huber, 2000, from Mexico. 1, *Ixchela abernathyi* (Gertsch, 1971), female from Km 227 Carretera Federal No. 70 Cd. San Luis Potosí-Rio Verde, San Luis Potosí. 2, *Ixchela placida* (Gertsch, 1971), female from Cueva de Atlahuilapa, Veracruz. 3, *Ixchela pecki* (Gertsch, 1971), female from Cueva de Teopisca, Chiapas. 4, *Ixchela simoni* (O. Pickard-Cambridge, 1898) from 2 km W of crossroad Omiltemi-Chautipan, Guerrero. 5, *Ixchela mixe* new species, female with egg sac from cave near Tlahuitoltepec, Oaxaca. 6, *Ixchela huberi* new species, male from Santa Inés del Monte, Oaxaca. 7, *Ixchela juarezi* new species, female with egg sac from 2 km E of Guelatao, Oaxaca. 8, *Ixchela taxco* new species, female from Rancho La Soñadora, 6 km W of Taxco, Guerrero. 9, *Ixchela franckei* new species, male from Cueva del Borrego, 3.5 km E of Omiltemi, Guerrero. 10–11, *Ixchela huasteca* new species: 10, male from 1.5 km road to Microondas La Pingüica, Querétaro; 11, female with egg sac from Buenavista, near Ahuacatlan, San Luis Potosí. 12, *Ixchela tzotzil* new species, male from Grutas de Arcotete, Chiapas.

Material and methods

The specimens used in this study were provided by the following museums and institutions: Colección Nacional de Arácnidos, Instituto de Biología, Universidad Nacional Autónoma de México, Mexico City (CNAN); American Museum of Natural History, New York, U. S. A. (AMNH); Texas Memorial Museum, University of Texas, Austin, Texas, U. S. A. (TMM-UT); Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica (INBio). Other institution cited: British Museum of Natural History, London, England (BMNH). There were several expeditions to different localities and states of Mexico to collect additional specimens of the described species and to find new species of *Ixchela*: 2009: Mexico City (June), Guerrero and Morelos (July), Oaxaca (September) and Querétaro (November). 2010: Veracruz (January), Oaxaca (March, April, May), San Luis Potosí (May), Guerrero (May, June, October), Michoacán (August), Puebla (September) and Hidalgo (November). 2011: Michoacán (April), Querétaro (May), Chiapas (June), Estado de México (August). 2012: Guerrero (January), Puebla (February). The specimens were collected manually and deposited in ethanol (80%). Some specimens were deposited in vials with ethanol (96% or 100%) for phylogenetic molecular studies (*in prep.*). The redescriptions of the five described species, as well as the descriptions of the new ones, were done following Huber (1998, 2000). All the holotypes and paratypes of the new species described here are deposited in the Colección Nacional de Arácnidos (CNAN), except the holotype and paratype of *Ixchela viquezi* deposited in INBio.

The specimens were examined, measured and photographed with a Nikon SMZ645 stereoscope. All measurements are in millimeters (mm). Taxonomic structures like female epigyna and male palps were dissected in ethanol (80%) and cleared in potassium hydroxide (KOH-10%) for a few minutes. Habitus, chelicerae, palps and epigyna were placed on 96% gel alcohol to facilitate positioning and covered with a thin layer of liquid ethanol (80%) to minimize diffraction during photography. The photographs were taken with a Nikon Coolpix S10 VR camera with adapter for the microscope. The maps were done with ArcView GIS version 3.2 (Applegate 1999). The photographs and maps were edited using Adobe Photoshop Version 7.0. The georeferencing of the localities without coordinates (collections done before the use of GPS as standard practice) was performed using the program GEOlocate version 2.02 (Rios & Bart 2010), and Google Earth-2011. Some localities were not georeferenced due to lack of accurate data on the labels. The localities were georeferenced using the coordinates format (latitude and longitude) in decimal degrees, because this is the only format with which the maps can be made in ArcView GIS version 3.2.

Abbreviations: ALE, anterior lateral eyes; AME, anterior median eyes; FAC, frontal apophysis of chelicerae; MSE, median septum of epigynum; PAB, prolateroventral apophysis of bulb; PLE, posterior lateral eyes; PME, posterior median eyes; PP, pore plates; SAC, sclerotized apophysis of chelicerae VAE, ventral apophysis of epigynum; VAF, ventrodistal apophysis of femur; VPP, ventrobasal protuberance of procursus.

Taxonomy

Pholcidae C. L. Koch, 1850

Ixchela Huber, 2000

Type species: *Ixchela furcula* (F. O. Pickard-Cambridge, 1902), originally described in *Coryssocnemis* Simon, 1893; by original designation (Huber, 2000). Type locality: 1 female holotype from Tecpam in the Región de los Altos (Cerro Tecpam, Departmento Chimaltenango), Guatemala, around 2300 m, Coll. Otto Stoll, Godman & Salvin Coll., in BMNH (F. O. Pickard-Cambridge, 1902; Huber, 1998).

Included taxa: *Ixchela simoni* (O. Pickard-Cambridge, 1898), *Ixchela abernathyi* (Gertsch, 1971), *Ixchela furcula* (F. O. Pickard-Cambridge, 1902), *Ixchela pecki* (Gertsch, 1971), *Ixchela placida* (Gertsch, 1971), *Ixchela mixe* new species, *Ixchela huberi* new species, *Ixchela juarezi* new species, *Ixchela grix* new species, *Ixchela taxco* new species, *Ixchela franckei* new species, *Ixchela tzotzil* new species, *Ixchela santibanezi* new species, *Ixchela huasteca* new species, and *Ixchela viquezi* new species.

Diagnosis: Distinguished by the prolateroventral apophysis of the palp bulb of the male (PAB) (Figs 26, 38, 66); by the apical-dorsal spine-shaped projection on the embolus (arrow Fig. 25; 53, 65), by the apical-vental projection on the embolus (arrow Fig. 26; 37, 53); by the curved spine distally on procursus (Figs 25, 37, 53); by the ventral protuberance with long setae on the procursus (VPP) (Figs 25, 37, 65); by the conical, straight and long procursus, wide basally (Figs 25, 37, 53); by the sclerotized small and sub-distal spine on the embolus (arrows Figs 38, 55, 80); and by the frontal apophysis of chelicerae on males (FAC) (Figs 22, 35, 75).

Description: Total length ~4.5–10 mm (prosoma+opisthosoma). Sexual dimorphism slight. Carapace with coloration pale yellow, light orange, beige or pale brown. Carapace with marginal brown or gray spots on some species (Figs. 32, 61, 73), absent or inconspicuous in others (Figs. 20, 48, 87). Clypeus brown, yellow or orange, with a wide, darker longitudinal region on some species (Figs. 51, 64) or without it in other species (Figs. 23, 33). Male clypeus unmodified (Figs 23, 33, 51). Ocular region moderately elevated, with eight eyes (Figs 19, 20, 23). Ocular region dark brown or dark orange, darkened posteriorly, near the fovea (Figs 32, 48, 61). Fovea of the carapace with irregular brown or gray region around (Figs 32, 48, 61); this region wide in some species (e.g. *I. furcula, I. simoni*) (Figs 32, 73), or thin in others (e.g. *I. pecki, I. mixe*) (Figs 48, 87). Female chelicerae unmodified. Male chelicerae with SAC on some species (e.g. *I. abernathyi, I. placida*) (Figs 21, 74), vestigial (e.g. *I. simoni, I. tzotzil*) (Figs 74, 162); or absent (e.g. *I. furcula, I. huberi*) (Figs 34, 100). Some species with SAC distally on FAC (e.g. *I. pecki, I. mixe*) (Figs 49, 88). Sternum wide, fused to the labium. Endites larger than wide, with retrolateral apophysis on males, absent on females. Labium and endites pale distally. Male palp with femur conical, wider distally than basally, with VAF (Figs 25, 37, 53), except *I. mixe* (Fig. 91). Male palp with tibia wide, wider distally than basally (Figs. 37, 53, 65). Palp tarsus dorsally with two distal apophyses (arrows Fig. 36). Tarsal organ exposed (e.g. *I. furcula*) (Huber 2000). Bulb rounded and wide (Figs 24, 26, 52, 54). Embolus conical and wide (Figs 25, 26, 65, 66). Embolus with two darker, longitudinal sclerotized lines, one dorsal (arrow Fig. 52, left arrow Fig. 53), and another ventral (right arrow Fig. 53); the ventral one projected from PAB (Figs 25, 37, 53). Legs long and robust, tibia I (length/diameter) (l/d) about 20–60; leg formula 1423 in most of the species, in some species 1243. Legs yellow, orange, reddish or brownish, darker on femora. Femora, tibiae and metatarsi with eight longitudinal rows of oblique setae, evenly spaced around the circumference. Legs with few small vertical setae along and around, without spines or curved setae. Three trichobothria on tibiae I, proximal, with the retrolateral trichobothria the most distal. Legs with numerous dark rings on femora and tibiae in some species (e.g. *I. abernathyi, I. tzotzil*) (Figs 1, 12) and in others without numerous rings, but with at least one basal ring and one sub-distal ring on femora and tibiae (e.g. *I. simoni, I. huberi*) (Figs 4, 6). Opisthosoma pale or dark blue, gray or pale green, with small white spots; globular in some species (e.g. *I. furcula, I. pecki*) (Figs 31, 47), and conical in others (e.g. *I. abernathyi, I. simoni*) (Figs 19, 72). Opisthosoma larger than high, except in *I. mixe* where it is higher than long (Fig. 86). Male gonopore without epiandrous spigots (e. g. *I. furcula*) (Huber 2000); gonopore plate oval, square or trapezoidal. Epigynum with different shapes, with paired or unpaired apophysis, long or small apophyses, wider than large or larger than wide (Figs 28, 39, 56, 69, 95). Epigynum internally with wide, paired PP, with MSE between PP (Figs 29, 40, 57); most of the species with sac-shaped concavities between MSE and PP (arrows Figs 57, 70), except *I. franckei, I. santibanezi* and *I. viquezi* (Figs 156, 184, 212). Epigynum in some species with one small rounded pit (e.g. *I. taxco, I. franckei*) (arrows Figs 142, 159).

Distribution: The genus *Ixchela* Huber, 2000 is widely distributed from Northeastern Mexico to Nicaragua. Although in this work I have not seen specimens from Nicaragua, Huber (2000) examined one male of an undescribed species from Nicaragua, Matagalpa, Fuente Pura, deposited in Museo Entomológico Nicaraguense, León, Nicaragua.

Natural History: The genus *Ixchela* has a natural distribution in temperate climate zones, principally in pine, oak or pine-oak forest, between 1000–2950 m of elevation (Figs 13–15, 17, 18; Appendix 1), although some species like *Ixchela santibanezi* new species was collected in tropical rain forest at 1190 m (Fig. 16), and *I. juarezi* new species was collected in a thorny scrub forest at 1900–2180 m. Although there has been a intensive collecting at low elevations, it seems that the genus *Ixchela* only occurs above 1000 m of elevation, while below this elevation only other genera such as *Physocyclus* Simon, 1893 and *Psilochorus* Simon, 1893 have been collected, principally in deciduous tropical forest. Bernhard A. Huber (*per. comm.*) said that the high altitude of the genus *Priscula* Simon, 1893 in South America seems to be a relict genus. Similarity, this could be the case for *Ixchela*, where again its high elevation distribution possibly reflects its relictual status.

The spiders sampled during new fieldwork were found among fallen logs, boulders on the ground, under dry leaves of agave plants and frequently on their irregular sheet webs on embankments along road-cuts, specifically in shaded, moist areas covered with roots and leaf-litter (Figs 15, 17, 18). In karstic zones, the spiders are found in their sheet webs frequently inside the caves (Fig. 14); on walls, holes in walls, among boulders on the floor, or among karst formations (stalagmites and columns) (Figs 1–3, 5, 9). Although some species have been collected frequently inside caves with relatively high densities, all species can be considered troglophiles and not strict troglobites or with conspicuous troglomorphic modifications (Figs 1–12).

FIGURES 13–18. Typical habitats of spiders of the genus *Ixchela* Huber, 2000 from Mexico. 13, Oak-pine forest, from Km 227 Federal Highway #70 Cd. San Luis Potosí-Rio Verde, San Luis Potosí: *Ixchela abernathyi* (Gertsch, 1970). 14, Karstic zone in oak-pine forest, Cueva del Borrego 3.5 km al E of Omiltemi, Guerrero: *Ixchela franckei* new species. 15, Oak-pine forest from Grutas de Arcotete, Chiapas: *Ixchela tzotzil* new species. 16, Tropical rain forest outside of Cueva de las Abejas, Chiapas: *Ixchela santibanezi* new species. 17, Oak-pine forest 3 km E of turn-off to Santa Inés del Monte, Oaxaca: *Ixchela huberi* new species. 18, Oak-pine forest at "Rancho La Soñadora", 6 km W of Taxco, Guerrero: *Ixchela taxco* new species. Red arrows indicate the specific locations or microhabitats where specimens of *Ixchela* can be collected in the field.

Key to identification of species of *Ixchela* Huber, 2000

Males

1.	Chelicerae with well developed SAC (Figs 21, 49, 62)	2
–	Chelicerae without or with inconspicuous SAC (Figs 34, 74, 100)	9
2 (1).	SAC distally, near the fang of chelicera (Figs 21, 62, 136)	3
–	SAC on basal half of chelicera, apically on FAC (Figs 50, 89, 176)	7
3 (2).	Chelicerae with FAC conical and long (Figs 22, 63, 137)	5
–	Chelicerae with FAC conical and small (Figs 150, 205)	4
4 (3).	Chelicerae with FAC wide basally with tip slightly curved (Figs 149, 150); embolus with basal protuberance conical, ending in round tip near PAB (Figs 153, 154); palp with small PAB (Figs 153, 154); palp femur wide and short, 2X longer than wide (Figs 152, 153); distal spine of procursus long, curved basally and straight distally (Figs 152, 153)	*Ixchela franckei* **new species**
–	Chelicerae with FAC small and narrowing evenly (Figs 204, 205); embolus without basal protuberance (Fig. 208); palp with large PAB (Figs 207, 208); palp femur thin and long (Figs 207, 208); distal spine of procursus long, straight basally and curved distally J-shaped (Figs 207–209)	*Ixchela viquezi* **new species**
5 (3).	Palp femur without ventral protuberances (Fig. 25, 65), chelicerae with FAC moderate, located on basal one third (Figs 22, 63)	6
–	Palp femur with a ventral conical protuberance (arrow Fig. 140); chelicerae with FAC large and curved, located basally (Figs 136, 137)	*Ixchela taxco* **new species**
6 (5).	FAC straight (Fig. 22); palp femur with retrolateral face with several setae medially (Fig. 25); PAB straight and wide, not forming a distinct notch between PAB and embolus (Fig. 26)	*Ixchela abernathyi* **(Gertsch, 1971)**
–	FAC slightly curved apically (Fig.63); palp femur with retrolateral face without setae medially (Fig. 65); PAB narrow and curved, forming a distinct notch between PAB and embolus (Fig. 66)	*Ixchela placida* **(Gertsch, 1971)**
7 (2).	PAB small and non-protruding (Figs 54, 181); SAC claw-shaped, long and pointing forward (Figs 49, 175)	8
	PAB strongly developed, distinctly protruding (Fig. 92); SAC hook-shaped, short, pointing towards each other (Figs 88–90)	*Ixchela mixe* **new species**
8 (7).	FAC short, located slightly distal to middle of chelicerae (Fig. 50), SAC oblique to mid-line of chelicerae (Fig. 49); SAC located in the middle of a large pale patch (Fig. 49)	*Ixchela pecki* **(Gertsch, 1971)**
–	FAC strongly developed, located on basal third of chelicerae (Fig. 176); SAC parallel to mid-line of chelicerae (Fig. 175); SAC basal to a small pale patch (Fig. 175)	*Ixchela santibanezi* **new species**
9 (1).	Chelicerae with SAC vestigial, but readily distinguished (Figs 74, 162)	10
–	Chelicerae without SAC (Figs 34, 100, 124)	13
10 (9).	Palp femur <2.5 X longer than wide (Figs 78, 192)	11
–	Palp femur >2.6 X longer than wide (Figs 115, 167)	12
11 (10).	In lateral view, FAC short and blunt (Fig. 75); ventral-distally, embolus with long and wide projection, leaf-shaped (Fig. 80); marginal pattern of coloration each side on carapace distinct, wide (Fig. 73)	*Ixchela simoni* **(O. Pickard-Cambridge, 1898)**
–	In lateral view, FAC rounded and protruding (Fig. 190); ventral-distally, embolus with long, thin, curved projection (Fig. 191); marginal pattern of coloration each side on carapace diffuse, narrow (Fig. 187)	*Ixchela huasteca* **new species**
12 (10).	FAC rounded, blunt; with narrow base (Fig. 113); frontal face of chelicerae angled, meeting medially at oblique angles (Fig. 112); palp femur distinctly angled on basal fourth (Figs 115, 116); embolus distally broad and blunt (Figs 115, 116); PAB long and thin, finger-like (Fig. 116); in frontal view, chelicerae evenly colored, pale (Fig. 112)	*Ixchela juarezi* **new species**
–	FAC conical; with broad base (Fig. 162); frontal face of chelicerae flat, meeting medially on the same plane (Fig. 162); palp femur not angled on basal fourth (Figs 167, 168); embolus distally tapering and narrow (Figs 166–168); PAB wide-based and short, thumb-like (Fig. 168); in frontal view, chelicerae with FAC region distinctly darker, contrasting with pale basal and distal regions (Fig. 162)	*Ixchela tzotzil* **new species**
13 (9).	Chelicerae with a pale region distal to FAC (Figs 33, 34); FAC long, conical, claw-shaped distally (Figs 34, 35); PAB with a distinct medial contriction (Fig. 38)	*Ixchela furcula* **(F. O. Pickard-Cambridge, 1902)**
–	Chelicerae without pale region distal to FAC (Figs 100, 124); FAC wide, short, blunt (Figs 101, 125); PAB tapering evenly, without a distinct medial constriction (Figs 104 , 129)	14
14 (13).	In lateral view, FAC wide and flat apically (Fig. 101); FAC directed frontally (Figs 100, 102); FAC distal face densely setose (Fig. 101); palp femur wide, <2.5 X longer than wide (Figs 103, 104); palp bulb oblongated (Fig. 104)	*Ixchela huberi* **new species**
–	In lateral view, FAC small and rounded apically (Fig. 125); FAC directed towards each other (Figs 124, 126); FAC distal face sparsely setose (Fig. 125), palp femur thin, >3 X longer than wide (Figs 128, 129), palp bulb rounded (Fig. 129)	*Ixchela grix* **new species**

Females

1.	Epigynum considerably longer than wide (Figs 41, 95, 119)	**2**
–	Epigynum as longer as wide or slightly wider than long (Figs 28, 56, 82)	**5**
2 (1).	Epigynum with a single long apophysis or without apophysis (Figs 121, 185)	**3**
–	Epigynum with paired apophyses (Figs 39, 95)	**4**
3 (2).	Epigynum with a ventral apophysis, very long, curved and conical (Figs 118–121); without pale region and without a concavity in posterior part (Figs 119, 121)	***Ixchela juarezi* new species**
–	Epigynum without apophysis, pear-shaped in ventral view (Fig. 183), with a small pale region in posterior part (Fig. 183), with a posterior concavity in lateral view (arrow, Fig. 185)	***Ixchela santibanezi* new species**
4 (2).	Epigynum wider anteriorly, with VAE close together (Figs 43, 44); VAE in anterior part, without rounded protuberance (Figs 39, 41, 43, 44)	***Ixchela furcula* (F. O. Pickard-Cambridge, 1902)**
–	Epigynum wider medially, with VAE separated from each other (Fig. 94); VAE on anterior rounded protuberance (Figs 94, 95, 97)	***Ixchela mixe* new species**
5 (1).	Epigynum with a conspicuous conical apophysis medially (Figs 59, 84, 109, 133)	**6**
–	Epigynum without a conspicuous apophysis (Figs 30, 71, 145, 158, 172)	**11**
6 (5).	Epigynum triangular in ventral view (Fig. 82)	***Ixchela simoni* (O. Pickard-Cambridge, 1898)**
–	Epigynum subquadrate in ventral view (Figs 56, 107, 131, 196, 211)	**7**
7 (6).	Epigynum triangular, pointed in frontal view (Figs 106, 130)	**8**
–	Epigynum subquadrate, blunt in frontal view (Fig. 58)	***Ixchela pecki* (Gertsch, 1971)**
8 (7).	Epigynum with distal pit (Figs 210, 211); PP longer than wide (Fig. 212)	***Ixchela viquezi* new species**
–	Epigynum without distal pit (Figs 106, 130 195); PP wider than long (Figs 108, 132, 200)	**9**
9 (8).	Epigynum in frontal view with lateral rounded protuberances (Figs 194, 195)	***Ixchela huasteca* new species**
–	Epigynum in frontal view without lateral protuberances (Figs. 106, 130)	**10**
10 (9).	Epigynum with apophysis basally (Figs 131, 133)	***Ixchela grix* new species**
–	Epigynum with apophysis medially (Figs 107, 109)	***Ixchela huberi* new species**
11 (5).	Epigynum triangular and without rounded apical, lateral corners in frontal view (Figs 142, 159)	**12**
–	Epigynum square and with rounded apical, lateral corners in frontal view (Figs 27, 68, 169)	**13**
12 (11).	Epigynum higher than wide in frontal view (Fig. 142); epigynum with anterior two third dark, posterior third pale (Fig. 143)	***Ixchela taxco* new species**
–	Epigynum wider than high in frontal view (Fig. 159); epigynum with anterior half pale and distal half dark (Fig. 155)	***Ixchela franckei* new species**
13 (11).	Epigynum in frontal view, with distal margin concave (Fig. 68); epigynum with two lateral prominent corners (Figs 68, 69, 71)	***Ixchela placida* (Gertsch, 1971)**
–	Epigynum in frontal view, with distal margin convex (Figs 27, 169); epigynum without prominent corners	**14**
14 (13).	Epigynum in frontal view with posteromedian area extending beyond posterior margin (Fig. 27); epigynum with small, rounded pit on posteromedian area (Figs 27, 28); epigynum oval in ventral view, wider basally than distally (Fig. 28)	***Ixchela abernathyi* (Gertsch, 1971)**
–	Epigynum in frontal view with posteromedian area not extending beyond posterior margin (Fig. 169); epigynum without small, rounded pit on posteromedian area (Figs 169, 170); epigynum trapezoidal in ventral view, wider distally than basally (Fig. 170)	***Ixchela tzotzil* new species**

Ixchela abernathyi (Gertsch, 1971)

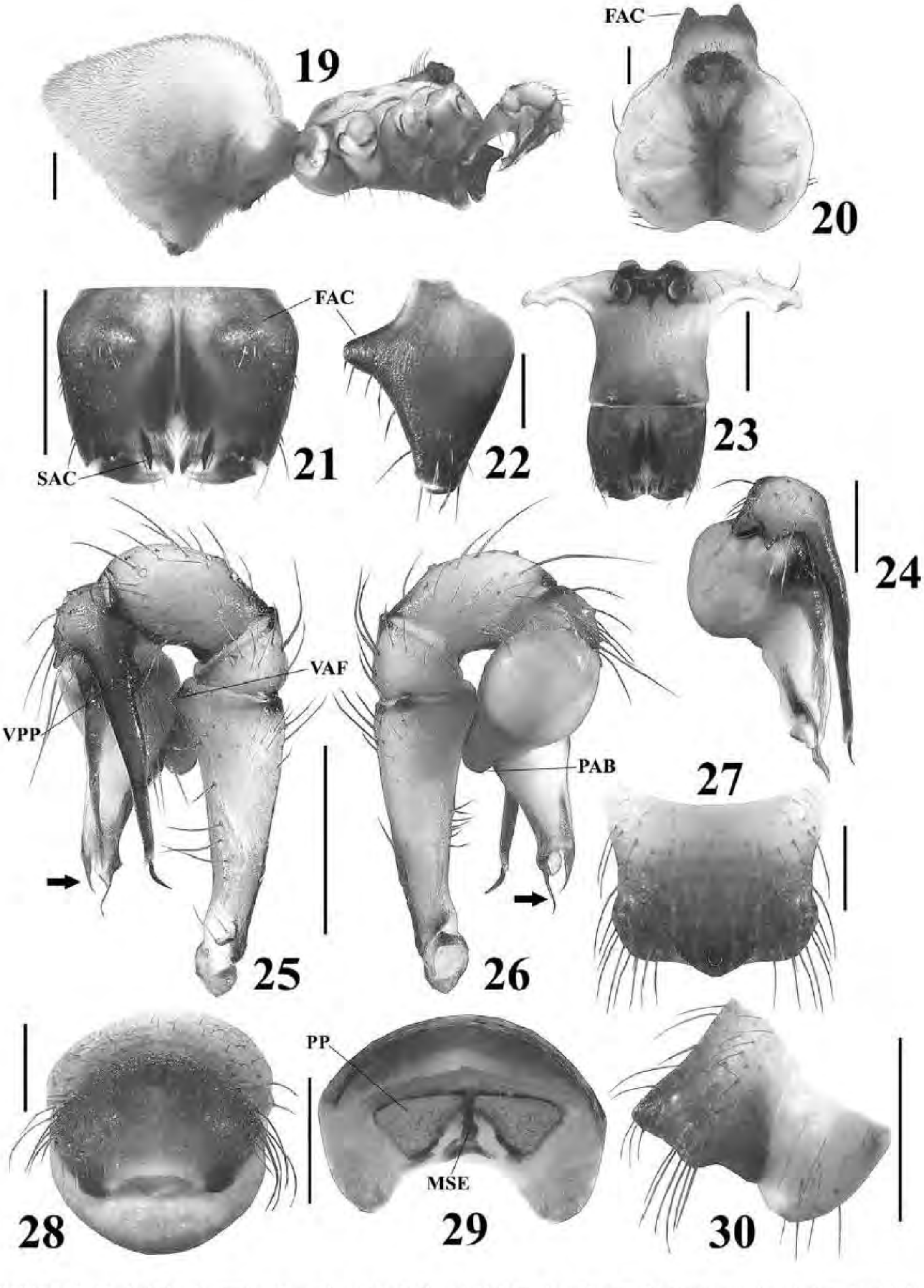
Figures 19–30

Coryssocnemis abernathyi Gertsch. 1971: 56, figs 19–22 (description ♂, ♀).
Coryssocnemis abernathyi Gertsch 1973: 147 (redescription ♂).
Ixchela abernathyi Huber, 2000: 153 (♂, ♀ transfer from Coryssocnemis).

Type data: *MEXICO: San Luis Potosí:* 1 ♂ holotype, 1 ♀ paratype (AMNH) (not examined) [30 January 1969; W. Elliot, D. Honea, M. Abernathy] from Sotano de Abernathy, W of Valle de los Fantasmas [~ lat 22.0796°, lon -100.6355°].

Material examined. *MEXICO: Coahuila:* 2 immatures (AMNH) [5 June 1966; J. Reddell] from Cueva de las Vigas 20 km E of Arteaga (lat 25.4609°, lon -100.6502°, 2271 m), found hanging from web along walls. 1 immature (TMM-UT Inv. Zoo. Coll. # 10,335) [3 September 1995; A. Cobb] from Cueva de Los Llanitos, 5 km NW Mesa de La Tablas (lat 25.2588°, lon -100.3535°, 2540 m). 2 immatures (TMM-UT Inv. Zoo. Coll. # 10,336) [16–17 July 1993; P. Sprouse] from Cueva de Los Llanitos, 1700 m N of Los Llanitos, 5 km NW Mesa de Las Tablas, Ejido el Potrero (lat 25.2588°, lon -100.3535°, 2540 m). *Nuevo León:* 1 ♂ (AMNH) [24 August 1973; D. McKenzie] from Sotano de Rancho Nuevo No. 4 (lat 23.8640°, lon -99.4154°; 1754m). 1 ♂ (AMNH) [13 October 1987; P. Sprouse] from Cueva de la Forja, 1 km N Chupaderos, 9 km W of Dulces Nombres. 1 immature (AMNH) [14–15 July 1986;

P. Sprouse] from Cueva de la Forja No. 2., Chupaderos. 2 immatures (AMNH) [22 March 1988: A. Cobb] from El Techito. 2.5 km S Ejido Cuauhtemoc, 6.5 km S of Revilla. 1 ♂ (AMNH) [24 August 1973; R. Jameson] from Sotano de Rancho Nuevo No. 3 (lat 23.8640°, lon -99.4154°; 1754m). 2 ♀♀, 1 immature (AMNH) [22 August 1973; R. Jameson, D. McKenzie] from Cueva de Rancho Revilla. 1 ♀, 3 immatures (AMNH) [21 March 1989; G. Veni, A. Cobb] from Cueva del Polvo Tempestado. 1 ♂, 1 ♀ (TMM-UT Inv. Zoo. Coll. # 52,510) [28 December 2004; J. Kennedy, C. Whitney] from Cueva Tronco Muerto, Mesa Colorada, Ejido de Laguna de Sánchez, Municipio de Santiago. 1 ♀ (TMM-UT Inv. Zoo. Coll. # 18,272) [22 November 1999; A. Guevara] from Pozo de Fernando, 4 km SW El Refugio. 1 immature (TMM-UT Inv. Zoo. Coll. # 51,642) [31 December 2001; P. Sprouse] from Pozo Nazca (PEP529), Chupaderos (lat 23.9700°, lon -99.6555°; 1995 m), Municipio de Zaragoza. 1 ♀ (TMM-UT Arth. Cat. # 6,809) [28 November 1981; P. Sprouse] from Poza de las Sardinas, 400 m N Rancho Nuevo Firetower. 1 ♀ (TMM-UT Inv. Zoo. Coll. # 24,131) [25 November 1999; C. Savvas] from Pozo Milenio (PEP432) (lat 23.8463°, lon -99.6869°; 2800 m), Santa María de Arriba, 20 km SE of Garza. 1 ♂ (TMM-UT Inv. Zoo. Coll. # 24,081) [22 November 1999; F. Vanoye] from Pozo Caldo (PEP440) (lat 23.8540°, lon -99.6879°; 2800 m), Santa Marta de Arriba, 20 km SE of Zaragoza. 1 ♂ (TMM-UT Inv. Zoo. Coll. # 10,312) [23 December 1996; J. Richards] from Pozo Seta, 3300 m NW Rancho Nuevo. 1 ♀ (TMM-UT Inv. Zoo. Coll. # 10,315) [21 November 1994; R. Savvas] from Pozo Nido de la Rata. 1 ♂, 1 immature (TMM-UT Inv. Zoo. Coll. # 10,321) [25 November 1993; C. Savvas] from Pozo Piso Falso, 2.5 km SSE of La Escondida (lat 24.0860°, lon -99.9071°). *San Luis Potosí:* 3 ♀♀ (CNAN 3345) [13 May 2010; A. Valdez, O. Francke, J. Cruz, C. Santibáñez] from Km 227 Carretera Federal No. 70 Cd. San Luis Potosí-Río Verde (lat 22.0884°, lon -100.6502°; 2344 m). 5 immatures (CNAN 3346) [13 May 2010; A. Valdez, O. Francke, J. Cruz, C. Santibáñez] from cave of the town named "Km 58" (lat 22.02°, lon -100.6015°; 2298 m), Municipio Villa de Zaragoza. 2 ♀♀, 1 immature (AMNH) [7 March 1972; J. Cooke] from Sotano de las Golondrinas (lat 21.5998°, lon -99.0990°; 856 m), Valle de los Fantasmas. 1 ♀, 1 immature (AMNH) [30 January 1969; W. Elliot, D. Honea, M. Abernathy] from Sotano de Abernathyi, W of Valle de los Fantasmas (lat 22.0784°, lon -100.6360°; 2450 m). 2 ♂♂ (AMNH) [28 November 1968; W. Elliot, J. Jarl] from Unnamed 30-foot-long cave, 1.2 km S of San Francisco. 1 ♂, 2 ♀♀, 2 immatures (AMNH) [29 November 1968; W. Elliott, J. Jarl, S. Cathey, M. Burk] from Sotano de las Golondrinas (lat 21.5998°, lon -99.099°; 856 m), Valle de los Fantasmas. 2 immatures (AMNH) [18 May 1972; W. Elliot] from Cueva de los Caballos (lat 22.0878°, lon -100.6581°; 2431 m), 30 km ESE San Luis Potosí (3000 m), Municipio Zaragoza. 1 ♀ (AMNH) [17 March 1972; W. Elliott, R. Mitchell, J. A. L. Cooke, G. Campbell, G. Graves, M. Brownfield] from Sotano de las Golondrinas (lat 21.5998°, lon -99.099°; 856 m), Puerto Altamira, 40 km E San Luis Potosí (3000 m). *Tamaulipas*: 1 immature (AMNH) [24 August 1973; R. Jameson, D. McKenzie, F. Pérez] from Cueva Tecolote (lat 23.8941°, lon -99.4527°). 3 immatures (AMNH) [20 April 1980; D. Honea, J. Williams] from Pozo Ciego, 1.5 km N Conrado. 1 ♀ (AMNH) [1 November 1979; P. Sprouse] from Pozo del Lagartijo 0.5 km SW Fire Tower. 1 immature (AMNH) [16 April 1979; P. Sprouse] from Sistema Purificación, Entrada de los Franceses. 3 immatures (AMNH) [17 March 1979; G. Atkinson] from Entrada del Viento Baja. 1 ♀ (AMNH) [22 March 1979; D. Pate] from Cueva del Musgo. 1 ♀ (AMNH) [25 April 1981; P. Sprouse, T. Treacy] from Cueva del Borrego, 0.5 km S Conrado Castillo. 1 ♀ (with ovisac) (AMNH) [24 April 1981; P. Sprouse] from Cueva X, Conrado Castillo. 1 ♀ [28 March 1978; A. G. Grubbs, P. Sprouse, T. Treacy, S. Balsdon] from Cueva X, Conrado Castillo. 1 ♀ (AMNH) [25 October 1979; T. Tracy, P. Sprouse] from Sistema de Purificación, Conrado Castillo. 2 ♀♀ (AMNH) [27 November 1979; J. Lieberz, P. Sprouse] from Sumidero de Oyamel. 1 ♂, 1 immature (AMNH) [10 April 1980; D. Honea, D. Pate] from Sistema Purificación, Sumidero de Oyamel. 1 immature (AMNH) [4 June 1980; P. Sprouse, T. Treacy] from Cueva del Pedernal, 2 km N Conrado Castillo. 1 ♀, 1 immature (AMNH) [14 March 1979; D. Pate, P. Sprouse, T. Treacy, L. Turpin] from Cueva del Brinco. 1 ♂ (AMNH) [15 January 1971; J. Reddell, W. Elliot] from Cueva Chica de la Perra, 13.5 km NW of Gomez Farias. 2 immatures (AMNH) [April 1980; D. Honea, J. Williams] from Cueva del Alacrán, 1.5 km N Conrado Castillo. 1 immature (AMNH) [Date?; Collectors?] from Cueva de la Capilla, 11.5 km NNE Gómez Farias. 1 ♂ (AMNH) [28 November 1986; P. Sprouse] from Cueva de los Chirriones, 3 km NW Los San Pedro. 1 ♂ (AMNH) [March–April 1978; A. G. Grubbs, C. Ediger, P. Sprouse, T. Treacy] from Conrado Castillo. 2 immatures (AMNH) [19 April 1980; T. Treacy, D. Pate, L. Clarfield, L. Will] from Cueva de Revilla, Revilla (Purification Area). 2 immatures (AMNH) [October 1979; P. Sprouse] from Entrada del Viento Baja, Conrado Castillo. 1 ♂ (TMM-UT Arth. Cat. # 6,811) [19 March 1982; D. Honea, J. Williams] from Cueva del Equinoccio, 500 m N Conrado Castillo. 1 ♀ (TMM-UT Arth. Cat. # 6,812) [6 April 1982; G. Atkinson] from Cueva de la Onza, 0.5 km N Conrado Castillo. 1 immature (TMM-UT Arth. Cat. # 6,813) [6 April 1982; P. Sprouse] from Cueva de la Onza, 0.5 km N Conrado Castillo. 1 ♀ (TMM-UT Arth. Cat. # 6,810) [15 March 1982; P. Sprouse, T. T Sprouse] from Pozo de Arrecife, 800 m NE Rancho Nuevo (lat 23.9438°, lon -99.4745°; 2240 m).



FIGURES 19–30. *Ixchela abernathyi* (Gertsch, 1971). Male: 19, Habitus, lateral view. 20, Carapace, dorsal view. 21, Chelicerae, frontal view. 22, Chelicerae, lateral view. 23, Carapace, frontal view. 24, Bulb and procursus, dorsal view. 25–26, Left palp, retrolateral and prolateral views respectively (arrows indicate the apical-dorsal projection spine-shaped on the embolus, and the apical-vental projection respectively). Female: 27, Epigynum, frontal view. 28, Epigynum, ventral view. 29, Epigynum, dorsal view. 30, Epigynum, left lateral view. Scales: 1 mm (Figs 19, 21, 23, 25, 26), 0.5 mm (Figs 20, 22, 24, 27–30).

Diagnosis. Resembles to *I. placida*, distinguished by FAC straight (Figs 21, 22); palp femur conical, wider than *I. placida* (Figs 25, 65); PAB rounded and bigger than *I. placida* (Figs 26, 66); and by the epigynum with three rounded angles at apex (Figs 27, 30) and with a small rounded pit on central apex (Figs 27, 28).

Description. Male. (Unnamed 30-foot-long cave, 1.2 km S of San Francisco). *Prosoma:* Carapace yellow, three small spots on each side (Fig. 20). Ocular region brown, brown region around fovea, brown line from PLE toward fovea (Fig. 20). Clypeus brown, darker distally (Fig. 23). Chelicerae dark brown, darker on prolateral part and pale on small region basally; with sclerotized and curved SAC (Fig. 21). Sternum brown, labium brown darker than sternum, pale distally. Endites dark brown, darker than sternum, pale distally. *Legs:* Coxae pale yellow, brown distally on prolateral and retrolateral parts. Trochanters brown. Femora yellow, with about 10 brown rings on femur I, 7 on II, 5 on III and 6 on IV; femora dark brown distally. Patellae brown. Tibia yellow, 6–7 brown rings on tibia I, 5–6 tibia II, 4 on III and 5–6 on IV. Metatarsi and tarsi orange. *Opisthosoma:* Conical distally, larger than high, pale blue coloration (Fig. 19). Plate of genital gonopore square. *Palp:* Femur with VAF (Fig. 25). Procursus long, VPP with long setae; curved spine distally (Fig. 25). Tibia with two long setae dorsodistally. Embolus wide and long, with spine dorsodistally and curved projection ventroapically (Figs 24–26). *Measurements:* Total length 9.40. Carapace 3.45 long, 3.2 wide. Clypeus 1.30 long. Diameter AME 0.16, ALE 0.19, PME 0.22, PLE 0.26. Distance ALE-PME 0.19, PME-PME 0.34. Leg I missing, tibia II: 11.80, tibia III: 9.50, tibia IV: 11.75. Tibia I l/d: missing.

Female. (CNAN 3345). Similar to the male, differences: *Prosoma:* Clypeus with X-shaped brown mark. *Epigynum:* Wider than high and long (Figs 27, 28, 30). PP triangular; MSE wide, posteriorly not touching PP (Fig. 29). Two sac-shaped concavities between MSE and PP (Fig. 29). *Measurements:* Total length 9.20. Carapace 2.85 long, 2.60 wide. Clypeus 1.05 long. Diameter AME 0.12, ALE 0.24, PME 0.20, PLE 0.22. Distance ALE-PME 0.18, PME-PME 0.26. Leg I: 43.06 (femur 11.25 + patella 1.13 + tibia 11.56 + metatarsi 14.25 + tarsi 4.87), tibia II: 8.50, tibia III: 6.81, tibia IV: 8.55; tibia I l/d 30.33.

Variation. Males and females have variation in size and coloration, even in specimens of each sex and from the same population, some specimens have legs brown and other specimens dark orange. Some specimens have rings on femur more marked than others. Some specimens have opisthosoma gray and others yellow. Male tibia I: 20.81–21.00 (x= 20.90). Female tibia I: 11.25–13.87 (x= 12.91).

Natural History. The specimens from km 227 Carretera Federal No. 70 Cd. San Luis Potosí-Rio Verde, San Luis Potosí, were collected in a karstic zone with pine-oak forest; the spiders were on their sheet webs among boulders and under fallen logs (Fig. 1). The specimens from cave of the town named "Km 58", Municipio Villa de Zaragoza, San Luis Potosí, were collected also in a karstic zone with pine-oak forest; the specimens were collected in the entrance and around 5m inside the cave, on their sheet webs on walls and among boulders on the floor.

Distribution. *MEXICO: San Luis Potosí, Tamaulipas* (Gertsch 1971, 1973), *Coahuila, Nuevo León* (Fig. 85).

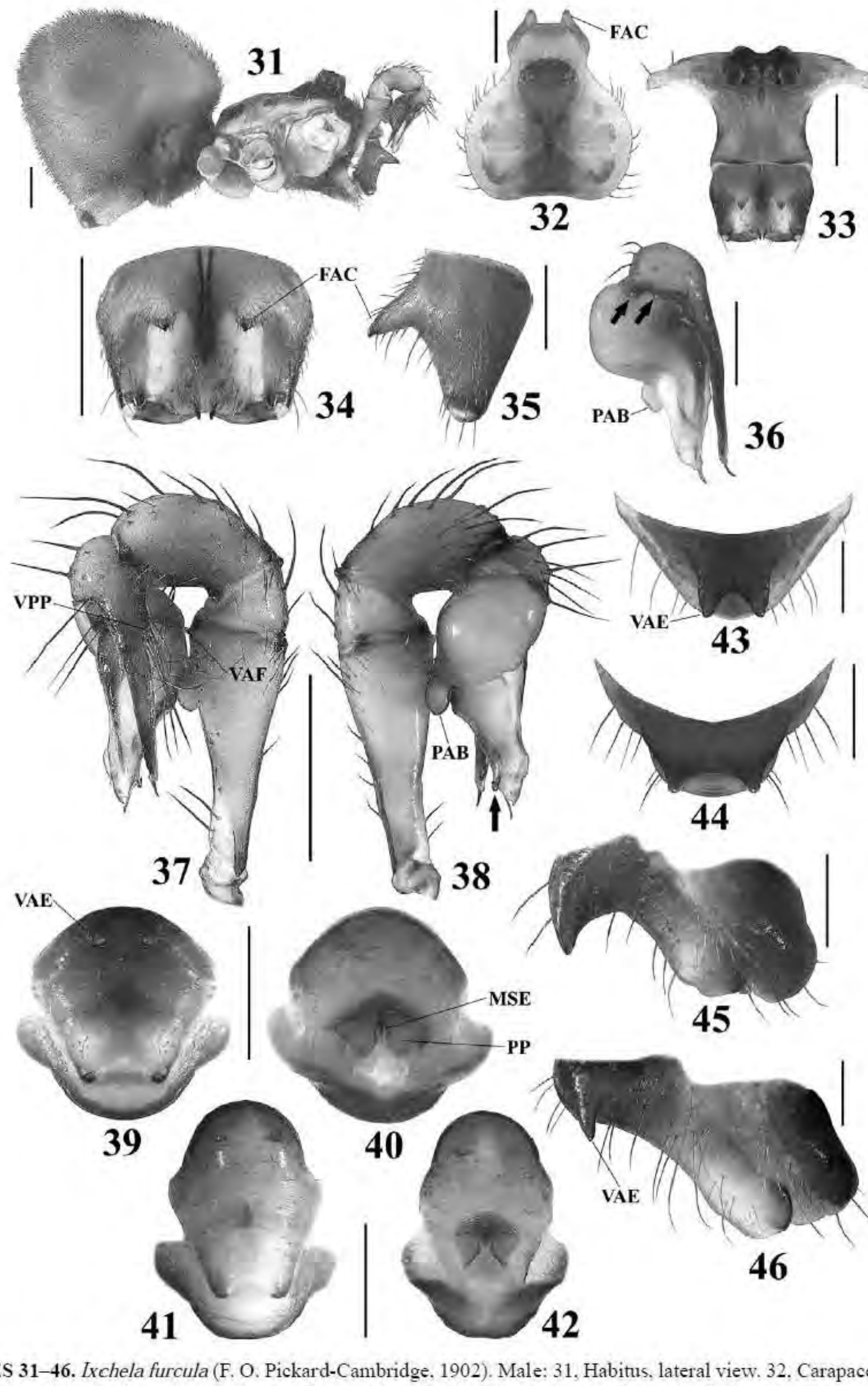
Ixchela furcula (F. O. Pickard-Cambridge, 1902)

Figures 31–46

Coryssocnemis furcula F. O. Pickard-Cambridge, 1902: 371, pl. 35, fig. 8 (description ♀).
Coryssocnemis furcula Kraus, 1955: 14, figs 22–23 (description ♂).
Coryssocnemis furcula Huber, 1998a: 63, figs 41–51 (description ♂♀).
Ixchela furcula Huber, 2000: 153, fig. 92 (♂♀ transfer from *Coryssocnemis*).

Type data: *GUATEMALA: Dept. Chimaltenango:* 1 ♀ holotype (BMNH) (not examined) [about 2300 m, no date (Stoll)] from "Tecpam in the Los Altos region" (Tecpan, Guatemala) (lat 14.761460°, lon -90.993791°; 2290 m).

Material examined. *GUATEMALA: Dept. Escuintla:* 2 ♂♂, 3 ♀♀ (AMNH) [6 February 1980; V. Roth] from San Vicente Picaya, near Amatitlán (lat 14.4144°, lon -90.6369°; 1530 m). *Dept. Sacatepequez:* 1 ♂, 5 ♀♀, 8 immatures (INBio) [Date?, Colls?] fom Cerro Alux (lat 14.6164°, lon -90.6332°; 2254 m). *HONDURAS: Dept. Francisco Morazán:* 1 ♂, 1 ♀ (AMNH) [2 October 1996; B. Huber] from Parque Nacional La Tigra, about 10 km NE Tegucigalpa (lat 14.2121°, lon -87.0950°, 1800–1900 m). 1 ♀ (INBio) [28 September 2008; C. Víquez] (same locality). 1 ♀ (INBio) [24 September 2008; C. Víquez] from Oyuca. *Dept. ?:* 1 ♀ (INBio) [30 September 2003; C. Viquez] from Celapre?, road nucleus and waterfall. 1 ♂, 1 ♀, 1 juvenile (INBio) [4 October 2003; C. Víquez] from Parque Nacional La Muralla, road Pizote. *EL SALVADOR: Dept. Santa Ana:* 1 ♀ (AMNH) [25 April 1951; O. Kraus] from Finca San Jorge near Santa Ana (lat 13.993950°, lon -89.551878°; 1000 m).



FIGURES 31–46. *Ixchela furcula* (F. O. Pickard-Cambridge, 1902). Male: 31, Habitus, lateral view. 32, Carapace, dorsal view. 33, Carapace, frontal view. 34, Chelicerae, frontal view. 35, Chelicera, lateral view. 36, Bulb and procursus, dorsal view (arrows indicate the two basal apophyses on dorsal part of procursus). 37–38, Left palp, retrolateral and prolateral views respectively (arrow indicates the sclerotized spine small and sub-distal on the embolus). Females: San Vicente de Picaya: 39–40, Epigynum, ventral and dorsal view respectively. 43, 45, Epigynum, frontal and lateral view respectively. Parque Nacional La Tigra: 41–42, Epigynum, ventral and dorsal view respectively. 44, 46, Epigynum, frontal and lateral view respectively. Scales: 1 mm (Figs 31–34, 37–42), 0.5 mm (Figs 35, 36, 43–46).

Diagnosis. Resembles to *I. santibanezi* and *I. mixe*. distinguished from *I. santibanezi* by FAC larger, claw-shaped distally (Figs 31–35); by the pale region below of FAC (Fig. 33, 34); by PAB larger, rounded and small, with a distinct medial contriction (Fig. 38); from *I. mixe* by the VAE anterior and paired, conical, close together (Figs 39, 41, 43–46).

Description. Male. (San Vicente Picaya). *Prosoma:* Carapace light orange, with three irregular brown spots each side (Fig. 32). Ocular region dark brown; irregular and wide brown region around the fovea from posterior part of ocular region to posterior margin of carapace (Fig. 32). Clypeus orange without lines or spots (Fig. 33). Chelicerae without SAC, with long and curved FAC (Figs 33–35). Chelicerae reddish in retrolateral part, pale region below FAC, dark orange above FAC (Figs 33, 34). Sternum orange, without lines or spots; labium brown. Endites dark brown, paler distally. *Legs:* Coxae orange, brown distally in prolateral and retrolateral part. Trochanters brown. Femora reddish, paler basally; distally with a wide ring, dark, inconspicuous. Tibiae reddish, subapically with a wide dark ring, inconspicuous. Metatarsi brown. Tarsi missing. *Opisthosoma:* Globular, green, slightly larger than high (Fig. 31). Plate of genital gonopore orange, wider than long. *Palp:* Femur conical, with small VAF (Figs 37, 38). Procursus conical and long, spine small and distally straight; VPP with long setae (Fig. 37). Embolus wide and long, dorsally with apical small spine (Figs 36 38); with sclerotized spine small and sub-distal (arrow Fig. 38); ventrally with apical projection curved and thin (Figs 37, 38). *Measurements:* Total length 7.80. Carapace 3.30 long, 3.20 wide. Clypeus 1.15 long. Diameter AME 0.16, ALE 0.28, PME 0.22, PLE 0.25. Distance ALE-PME 0.19, PME-PME 0.33. Leg I: ? (11.87+1.40+12.06+missing+missing), tibia II: missing, tibia III: 6.95, tibia IV: missing; tibia I l/d 20.10.

Female. (Same data as male). Similar to the male, differences: *Prosoma:* Carapace orange, paler than the male. Clypeus brown. Chelicerae orange, darker retrolaterally. Sternum orange lighter than the male. *Legs:* Coxae orange paler than male. Femora, tibiae, metatarsi and tarsi orange. Femora with wide ring subapically. Tibiae with brown basal ring, and wide brown ring subapically. *Epigynum:* Slightly wider than long (Fig. 39). PP triangular laterally; MSE slender distally, ending in tip (Fig 40). VAE paired, conical, long and wide (Figs 39, 43, 45). *Measurements:* Total length 8.00. Carapace 3.00 long, 2.80 wide. Clypeus 1.00 long. Diameter AME 0.13, ALE 0.27, PME 0.20, PLE 0.25. Distance ALE-PME 0.20, PME-PME 0.32. Leg I: ? (9.50+missing+missing+missing+missing), tibia II: 7.00, tibia III: 5.55, tibia IV: 7.60; tibia I l/d ?.

Variation. Males from San Vicente Picaya, Guatemala have the darkest legs of all the males. Males from Cerro Alux, Guatemala and La Muralla, Honduras have several brown spots around the legs, specifically at the insertion pont of each setae, more conspicuous in males from Cerro Alux than males from La Muralla. There is discontinuous variation in the epigyna, the criterion to assign the females into the same species is that the males from the different localities had the same morphological characters without variation in sexual structures (chelicerae and palps). Females from San Vicente Picaya and Cerro Alux (the nearest locality from type locality), have long and wide VAE (Figs 39, 43, 45; see fig. 51 in Huber, 1998 from Pinajachel, Guatemala); females from Parque Nacional La Tigra and Parque Nacional La Muralla have small VAE, and epigynum larger than females from San Vicente de Picaya (Figs 41, 44, 46; see fig. 48, 49 in Huber, 1998). There is variation internally in epigyna; females from San Vicente Picaya have MSE larger and PP larger than females from Parque Nacional La Tigra (Figs 40, 42). *Males:* San Vicente Picaya (N= 2), tibia I: missing. Parque Nacional La Tigra (N= 1), tibia I: missing. Cerro Alux (N= 1), tibia I: 10.00. Parque Nacional La Muralla (N= 1), tibia I: missing. *Females:* San Vicente Picaya (N= 2), tibia I: missing. Parque Nacional La Tigra (N= 1), tibia I: missing. Cerro Alux (N= 2), tibia I: 9.50, 9.00. Parque Nacional La Muralla (N= 1), tibia I: missing.

Natural History: From Huber (1998): "The spiders were found in sheet webs close to the ground, mostly in dark sheltered places, along creeks (Panajachel, Zunil) or footpaths (Parque Nacional La Tigra). When disturbed the spiders fled into a funnel that led into the substrate, much like agelenids, but with the difference that the funnel was the continuation of the underside of the sheetweb".

Distribution. *GUATEMALA* (F. O. Pickard-Cambridge 1902, Huber 1998), *HONDURAS* (Huber 1998), *EL SALVADOR* (Huber 1998) (Fig. 85).

Ixchela pecki (Gertsch, 1971)
Figures 47–59

Coryssocnemis pecki Gertsch, 1971: 58, figs 4–18 (description ♂♀).
Coryssocnemis pecki Huber, 1998c: 595, fig. 8F (♂).
Ixchela pecki Huber, 2000: 153 (♂♀ transfer from *Coryssocnemis*).

Type data: *MEXICO: Chiapas:* 1 ♂ holotype (not examined), 2 ♂♂ and 6 ♀♀ paratypes (examined) (AMNH) [15 August 1969; S. Peck, J. Peck] from Grutas de Arcotete (lat 16.7254°, lon -92.5846°, 2323 m), 6 km E of San Cristóbal de las Casas, Municipio San Cristóbal de las Casas.

Material examined. *MEXICO: Chiapas:* 2 ♂♂ and 6 ♀♀ paratypes, 8 immatures (AMNH) (same data as holotype). 4 immatures (AMNH) [13 August 1969; S. Peck, J. Peck] from Cueva Rancho Nuevo (lat 16.6673°, lon -92.5649°; 2339 m), 10 km E of San Cristóbal de las Casas, Municipio San Cristóbal de las Casas. 2 ♂♂, 4 ♀♀, 15 immatures (CNAN 3347) [17 June 2011; A. Valdez, O. Francke, C. Santibáñez, J. Cruz, R. Monjaraz, G. Contreras, K. Zárate] from Cueva de Teopisca (lat 16.5455°, lon -92.4952°; 1825 m), Municipio Teopisca.

Diagnosis. Resembles *I. mixe*, distinguished by the short FAC with long sclerotized claws apically, larger than *I. mixe*, almost on median part of chelicerae above a pale region, inwardly directed, located on median part (Figs 49–51); by PAB smaller than *I. mixe* (Fig. 54); and by epigyna with an oval and small ventral apophysis on anterior part (Figs 56, 58, 59).

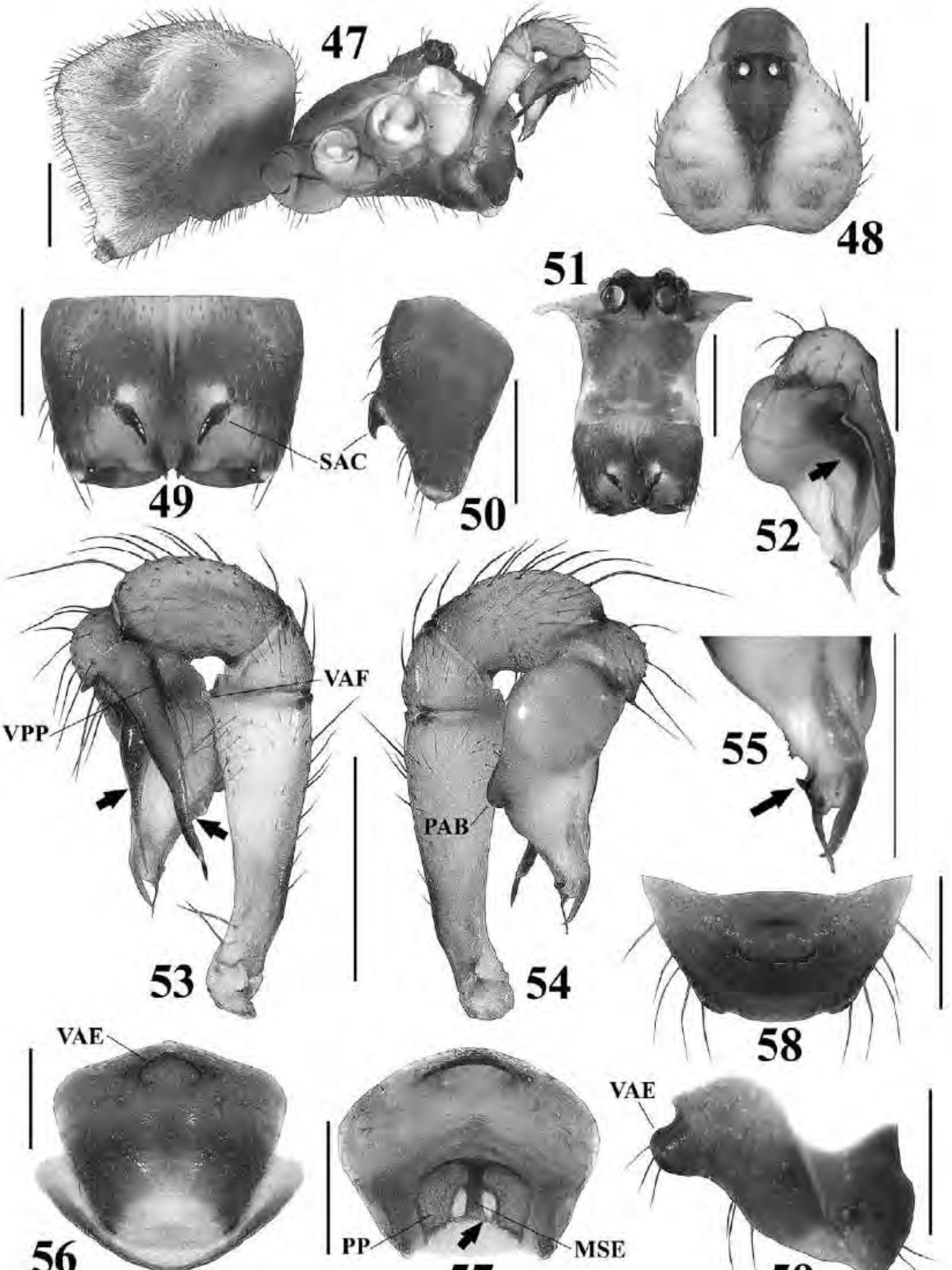
Description. Male. (CNAN 3347). *Prosoma:* Carapace beige, without spots, with a pale gray region in distal marginal part (Fig. 48). Ocular region brown; pale gray V-shaped around the fovea (Fig. 48). Clypeus with a wide longitudinal brown region (Fig. 51). Chelicerae brown, with pale region in median part below FAC (Fig. 49). Sternum pale orange, darker distally; labium dark brown, pale distally; endites brown, pale distally, and yellow on the retrolateral apophysis. *Legs:* Coxae yellow, pale brown in prolateral and retrolateral parts. Trochanters orange. Femora brown, paler basal and distally; without numerous rings, only a wide gray ring sub-distally, inconspicuous. Patellae dark gray. Tibiae orange, paler distally; with a wide gray ring sub-distally, inconspicuous. Metatarsi and tarsi orange. *Opisthosoma:* Globular, pale blue, larger than high (Fig. 47). Gonopore plate gray, trapezoidal. *Palp:* Femur yellow orange, paler ventrally; conical, VAF small and curved (Fig. 53). Patella and tibia dark orange. Procursus orange basally, darker distally; conical, with distal spine straight; with two dorsal basal projections (Fig. 53). VPP with long setae (Fig. 53). Embolus conical, with sclerotized retrolateral dorsal region longitudinal; sclerotized ventral line longitudinal, projected from PAB (Fig. 53). Embolus with long and thin spine distally (Figs 53 55); sub-distally with prolateral sclerotized, curved projection (Fig. 55). *Measurements:* Total length 6.10. Carapace 2.90 long, 2.70 wide. Clypeus 1.07 long. Diameter AME 0.07, ALE 0.22, PME 0.18, PLE 0.23. Distance ALE-PME 0.10, PME-PME 0.29. Leg I: 56.82 (14.87+1.15+14.37+21.81+4.62), tibia II: 10.62, tibia III: 8.80, tibia IV: 10.25; tibia I l/d 39.16.

Female. (CNAN 3347). Similar to the male, differences: *Prosoma:* Ocular region brown, lighter than the male. Clypeus with brown region longitudinal region, paler than on the male. Chelicerae pale brown. Sternum pale orange, paler than on the male. Labium dark brown, paler than on the male. Endites brown, paler than on the male. *Legs:* Coxae yellow, paler than on the male. Trochanters orange, paler than on the male. Femora, tibiae, metatarsi and tarsi orange, paler than on the male. *Epigynum:* Wider than long, brown (Fig. 56). PP curved, MSE wide, with big sac-shape concavities between MSE and PP (Fig. 57). *Measurements:* Total length 6.10. Carapace 2.37 long, 2.15 wide. Clypeus 0.97 long. Diameter AME 0.07, ALE 0.20, PME 0.17, PLE 0.21. Distance ALE-PME 0.09. PME-PME 0.24. Leg I: 47.40 (12.50+0.97+12.31+16.87+4.75), tibia II: 8.85, tibia III: 7.35, tibia IV: 8.75; tibia I l/d 32.66.

Variation. There is variation in coloration. Males have ocular region, clypeus and legs darker brown than the females. Male tibia I: 14.37 (missing in two males). Female tibia I: 10.62–12.50 ($\bar{x}$= 11.65).

Natural History. The spiders were collected inside the cave about 60m from the entrance, in their irregular sheet webs on the walls and among boulders and karst formations (stalagmites and columns) (Fig. 3). The cave showed a high degree of human disturbance, because the people that live in the nearby town make religious ceremonies inside the cave.

Distribution. *MEXICO: Chiapas* (Gertsch 1971) (Fig. 85).



FIGURES 47–59. *Ixchela pecki* (Gertsch, 1971). Male: 47. Habitus, lateral view. 48. Carapace, dorsal view. 49. Chelicerae, frontal view. 50. Chelicera, lateral view. 51. Carapace, frontal view. 52. Bulb and procursus, dorsal view (arrow indicates the dorsal sclerotized line on embolus). 53–54. Left palp, retrolateral and prolateral views respectively (arrows in Fig. 53 indicate the dorsal sclerotized line (left arrow), and ventral sclerotized line on embolus (right arrow)). 55. Left embolus, prolateral-dorsal view (arrow indicates the sclerotized spine small and sub-distal on the embolus). Female: 56. Epigynum, ventral view. 57. Epigynum, dorsal view (arrow indicates the sac-shaped concavities between MSE and PP). 58. Epigynum, frontal view. 59. Epigynum, left lateral view. Scales: 1 mm (Figs 47, 48, 51, 53, 54), 0.5 mm (Figs 49, 50, 52, 55–59).

Ixchela placida (Gertsch, 1971)

Figures 60–71

Coryssocnemis placidus Gertsch, 1971: 57, figs 28–29 (description ♀).
Coryssocnemis placida Brignoli, 1983: 161.
Ixchela placida Huber, 2000: 153 (♂♀ transfer from *Coryssocnemis*).

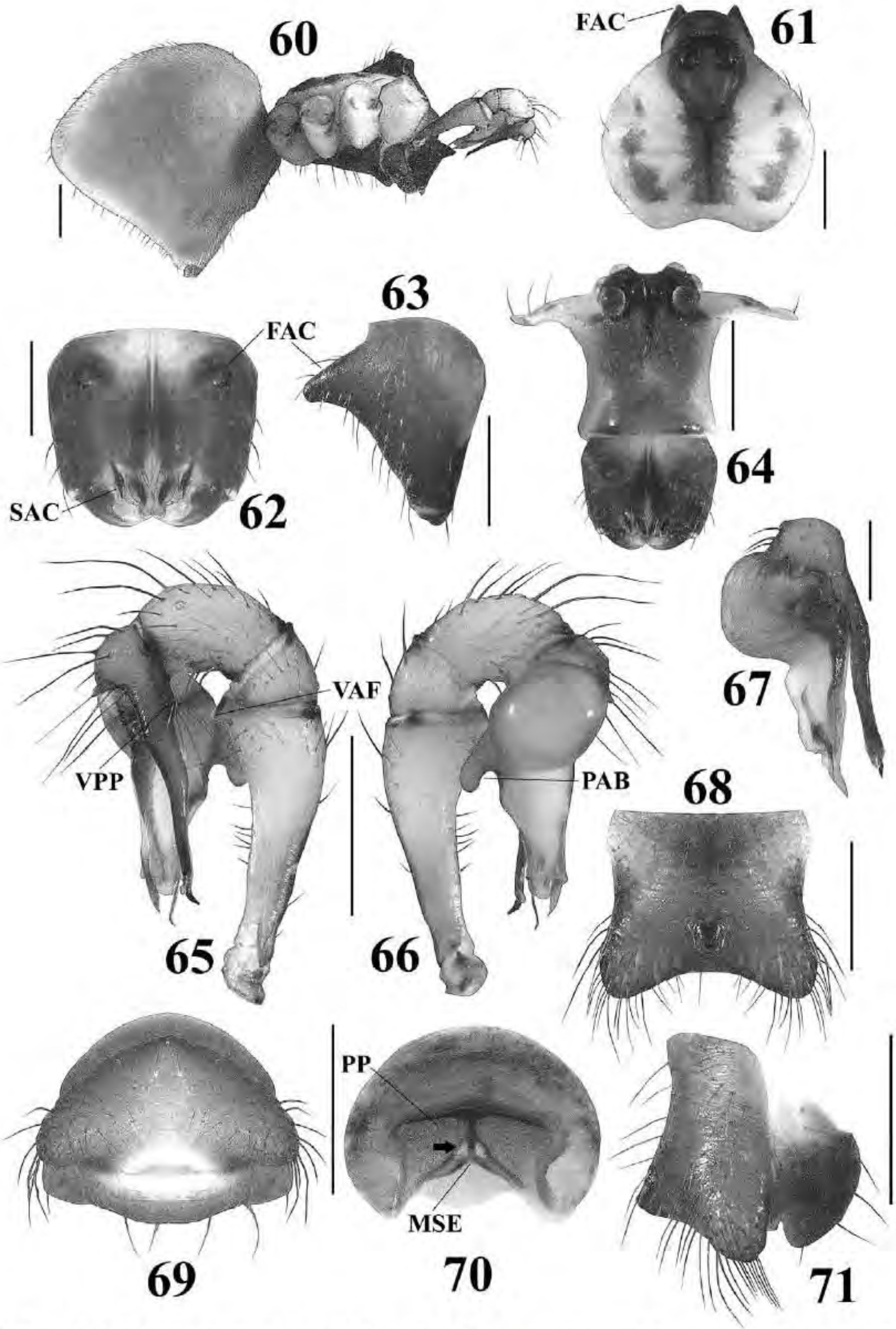
Type data: *MEXICO: Veracruz:* 1 ♀ holotype (AMNH) (not examined) [8 August 1967; J. Reddell] from Cueva de Ojo de Agua de Tlilapan (lat 18.8065°, lon -97.1014°, 1176 m), Municipio Tlilapan.

Material examined. *MEXICO: Veracruz:* 1 ♀, 3 immatures (AMNH) [5 January 1974; W. Elliott] from Sotano del Hombre Invisible, Soledad Atzompa (lat 18.7545°, lon -97.1515°, 2109 m), Municipio Soledad Atzompa. 1 ♂, 1 immature (AMNH) [5 January 1974; J. Reddell, W. Elliott, R. Jameson, D. McKenzie] from Cueva de Mazatopa, Soledad Atzompa (lat 18.7545°, lon -97.1515°; 2109 m), Municipio Soledad Atzompa. 1 immature (AMNH) [June 1963; D. McKenzie] from Sotano del Oztauatlilztaloa, 0.5 km NW of Tequila (lat 18.7324°, lon -97.0734°; 1705 m), Municipio Tequila. 1 immature (AMNH) [6 August 1967; J. Reddell, T. Evans] from Sotano de Sphodrini, Tequila (lat 18.7295°, lon -97.0710°; 1679 m), Municipio Tequila. 2 immatures (AMNH) [6 August 1967; J. Reddell, J. Fish, T. Evans] from Rock Quarry, 10.5 km on Tequila-Zongolica Road (lat 18.6823°, lon -97.0561°, 1920 m). 1 immature (AMNH) [5 August 1967; J. Reddell, T. Evans] from Cueva de Opilionida, 1.6 km N of Tequila (lat 18.7438°, lon -97.0693°; 1860 m). 4 ♀♀ (2 with egg sac) (CNAN 3348-3351) [22 January 2010; A. Valdez, O. Francke, C. Santibáñez, J. Cruz] from Cueva de Atlahuilapa (lat 18.7037°, lon -97.0855°; 1142 m) (oak-pine forest), Municipio Atlahuilco. 5 ♂♂, 9 ♀♀, 5 immatures (CNAN 3352) (same anterior data). 1 ♂, 1 ♀ (CNAN 3353) [13 May 2011; O. Francke, J. Cruz, I. Bokma, G. Contreras] (same anterior locality). 1 ♀ (TMM-UT Inv. Zoo. Coll. # 10,326) [25 March 1995; P. Sprouse] from Cueva de Xometla, 800 m E of Atlahuilco, Municipio Atlahuilco. *Puebla:* 1 ♂, 1 ♀ (AMNH) [January 1978; P. S. Strickland] from Zoquitlán, 2nd River Cave (lat 18.3362°, lon -97.0201°; 2220 m), Municipio Zoquitlán. 1 ♂, 1 ♀ (AMNH) [January 1977; P. Strickland, P. Forsythe, F. Poer, J. Rodemarker] from Sotano of Log-Filled Sink, Zoquitlán, Municipio Zoquitlán.

Diagnosis. Close relative of *I. abernathyi*, distinguished by FAC slightly curved apically (Figs 62, 63); by palp femur slightly curved in dorsal-distal part (Figs 65, 66); by PAB curved and thinner, forming a notch between PAB and embolus (Fig. 66); by opisthosoma less conical (Fig. 60); by a wide brown region longitudinal on clypeus (Fig. 64), absent on *I. abernathyi* (Fig. 23); by having a single darker sub-distal ring on the femora, *I. abernathyi* has numerous rings along femora and tibiae; and by epigynum with two lateral prominent corners (Figs 68, 69, 71); in frontal view, with distal margin concave (Fig. 68).

Description. Male. (CNAN 3352). *Prosoma:* Carapace beige; ocular region brownish, with small pale brown region behind PME (Fig. 61); a wide dark brown region around the fovea (Fig. 61); and with lateral spots fused, forming two longitudinal brown blotches (Fig. 61). Clypeus with a wide longitudinal brown region (Fig. 64). Chelicerae brown, with SAC (Fig. 62). Sternum and endites dark brown (Fig. 60). Labium darker brown than sternum, distally pale. Endites distally pale. *Legs:* Coxae pale yellow, small brown region in prolateral and retrolateral parts. Trochanters brown. Femora dark brown, paler basally becoming orange; without numerous rings, only a wide sub-distal gray ring. Patellae dark gray. Tibiae, metatarsi and tarsi brown, paler than femora; tibiae with one gray basal ring and another one distally. *Opisthosoma:* Semi conical, slightly larger than high, with dark blue coloration (Fig. 60). Gonopore plate oval. *Palp:* Femur with small VAF (Fig. 65). Procursus long, sigmoidal, with small and curved distal spine (Figs 65, 67). Embolus distally with dorsal spine-shaped projection; ventrally with apical projection, thin and curved (Figs 65, 66). *Measurements:* Total length 7.30. Carapace 2.90 long, 2.85 wide. Clypeus 1.15 long. Diameter AME 0.14, ALE 0.26, PME 0.19, PLE 0.24. Distance ALE-PME 0.18, PME-PME 0.34. Leg I 56.0 (15.50+1.23+14.25+19.62+5.40), tibia II: 10.87, tibia III: 8.85, tibia IV: 10.87. Tibia I l/d: 29.12.

Female. (CNAN 3352). Similar to the male, differences: *Legs:* Femore with wide gray sub distal ring, darker than the male. Patellae darker gray than on the male. Tibiae with basal and distal gray rings darker than on the male. *Epigynum:* Wider than long and high (Figs 68, 69). PP with lateral concavity; MSE thin, with Y-shaped upside down (Fig. 70). Long concavities between MSE and PP (Fig. 70). *Measurements:* Total length 8.70. Carapace 3.50 long, 3.20 wide Clypeus 1.35 long. Diameter AME 0.14, ALE 0.30, PME 0.23, PLE 0.28. Distance ALE-PME 0.23, PME-PME 0.33. Leg I: 63.17 (16.37+1.50+16.00+23.00−6.30), tibia II: 12.00, tibia III: 9.50, tibia IV: 11.75; tibia I l/d 31.75.



FIGURES 60–71. *Ixchela placida* (Gertsch, 1971). Male: 60, Habitus, lateral view. 61, Carapace, dorsal view. 62, Chelicerae, frontal view. 63, Chelicera, lateral view. 64, Carapace, frontal view. 65–66, Left palp, retrolateral and prolateral views respectively. 67, Bulb and procursus, dorsal view. Female: 68, Epigynum, frontal view. 69, Epigynum, ventral view. 70, Epigynum, dorsal view (arrow indicates the sac-shaped concavities between MSE and PP). 71, Epigynum, left lateral view. Scales: 1 mm (Figs 60, 61, 64, 65, 66, 68–71), 0.5 mm (Figs 62, 63, 67).

Variation. The ophistosoma on some males and females is blue and on others is green in life. There is minor variation in the total length in males, but among the females there is a marked continuous variation. Male tibia I: 14.25–16.25 (x= 14.97). Female tibia I: 10.00–17.00 (x= 14.15).

Natural History. The specimens from Cueva de Atlahuilapa were collected on their sheet webs 5–8 m inside the cave, primarily close to the walls (Fig. 2). The specimens were collected relatively close to each other. The cave had high humidity, ca 80%, and was fairly cold, because of a small river inside. The cave is located in a large karstic zone, in oak-pine forest at 1142 m elevation.

Distribution. *MEXICO: Veracruz* (Gertsch 1971), *Puebla* (Fig. 85).

Ixchela simoni (O. Pickard-Cambridge, 1898)

Figures 72–84

Coryssocnemis simoni O. Pickard-Cambridge, 1898: 237, pl. 31, fig. 9 (description ♀).
Coryssocnemis simoni F. O. Pickard-Cambridge, 1902: 371, pl. 35, fig. 7 (♀).
Ixchela simoni, Huber, 2000: 153 (♂♀ transfer from *Coryssocnemis*).

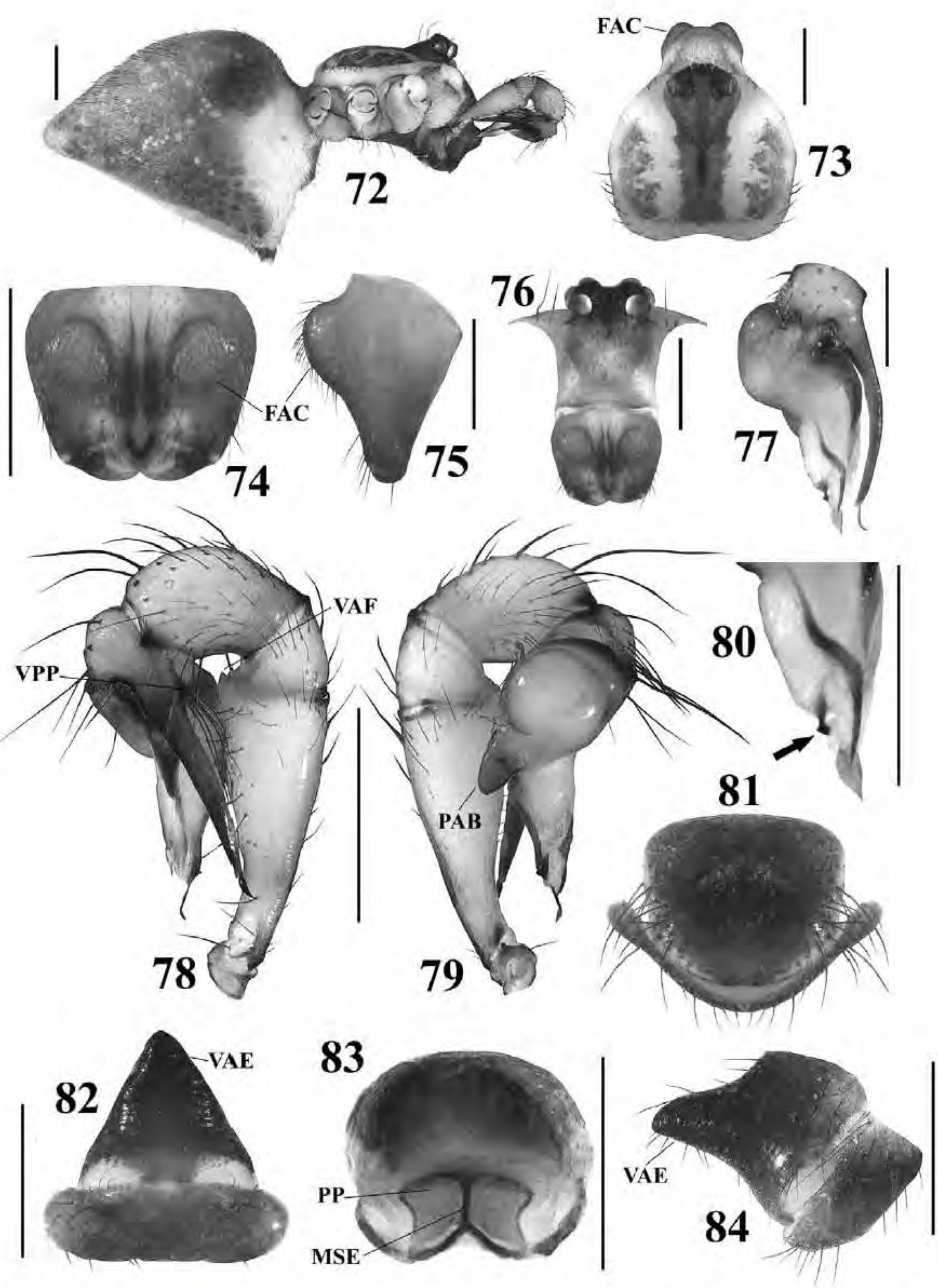
Type data. *MEXICO*: *Guerrero*: 1 ♀ holotype (BMNH) (not examined), from Omiltemi [~ lat 17.5564°, lon -99.6882°], Municipio Chilpancingo [H. H. Smith].

Material examined. *MEXICO*: *Guerrero*: 2 ♂♂, 2 ♀♀, 2 immatures (CNAN 3320) [25 January 2012; A. Valdez, O. Francke, D. Ortiz, J. Mendoza, G. Contreras] from 2 km W of crossroad Omiltemi-Chautipan (lat 17.5552°, lon -99.7236°; 2448 m), Municipio Chilpancingo. 1 immature (CNAN 3321) [25 January 2012; A. Valdez, O. Francke, D. Ortiz, J. Mendoza, G. Contreras] from 1 km E of Omiltemi (lat 17.5561°, lon -99.6729°; 1985 m), Municipio Chilpancingo. 2 immatures (CNAN 3322) [25 January 2012; A. Valdez, O. Francke, D. Ortiz, J. Mendoza, G. Contreras] from 2 km W of Omiltemi (lat 17.5481°, lon -99.6956°; 2216 m), Municipio Chilpancingo. 4 immatures (CNAN 3328) [23 July 2009; A. Valdez, O. Francke, H. Montaño, C. Santibañez, T. López, C. Quijano] from Omiltemi (lat 17.5546°, lon -99.6853°; 2623 m), Municipio Chilpancingo. 1 ♀ (TMM-UT Inv. Zoo. Coll. # 52,512) [29 December 2002; P. Sprouse] from Acahuizotla, Resumidero de San Juan Francisco (lat 17.3253°, lon -99.3909°; 1222 m).

Diagnosis. Close relative of *I. huberi*, distinguished by chelicerae with FAC rounded and smaller (Figs 74, 75); rounded apically in lateral view (Fig. 75); by the palp femur larger (Figs 78, 79); by the embolus ventral-distal with long projection leaf-shaped (Fig. 80); and by epigyna with prominent conical apophysis (Fig. 82), slightly curved in lateral view (Fig. 84).

Description. Male. (CNAN 3320). *Prosoma:* Carapace pale yellow, with lateral wide spots, olive color (Fig. 73). Ocular region brown, with a wide longitudinal olive line; two shorts olive lines behind the posterior median eyes (Fig. 73). Fovea with a wide spot aroud it, olive color (Fig. 73). Clypeus with a wide trapezoidal region along, olive color (Fig. 76). Chelicerae dark brown on prolateral and retrolateral parts; prolaterally small pale region on basal and distal parts. FAC brown, quelicerae with inconspicuous SAC (Fig. 74). Sternum orange, labium and endites brown, pale distally, prolateral apophysis of endites orange. *Legs:* Coxae pale yellow. Trochanters brown. Femora orange, paler basally and distally, with a marked width ring sub-distally. Patellae dark. Tibiae light brown, with a dark wide ring basally and other one distally. Metatarsi and tarsi brown. *Opisthosoma:* Conical, pale blue, larger than high (Fig. 72). Gonopore plate olive color, rounded. *Palp:* Femur pale orange, conical, thin basally and wide distally; with VAF small, projected upward (Fig. 78). Patella pale orange. Tibia orange, paler basally. Procursus brown, paler basally; conical with distal curved spine; with two dorsal basal projections (Fig. 77). VPP rounded, with numerous long setae (Fig. 78). Embolus conical (Figs 78, 79), with sclerotized spine small and sub-distal on the embolus (arrow Fig. 80). PAB long and wide (Fig. 79). Embolus with long curved dorsal-distal spine; ventrally with sclerotized long projection leaf-shaped (Fig. 80). *Measurements:* Total length 7.40. Carapace 2.85 long, 2.50 wide. Clypeus 1.07 long. Diameter AME 0.14, ALE 0.24, PME 0.20, PLE 0.22. Distance ALE-PME 0.18, PME-PME 0.26. Leg I: 40.19 (10.81+1.02+10.62+13.12+4.62), tibia II: 7.25, tibia III: 5.70, tibia IV: 7.40; tibia I l/d 21.50.

Female. (CNAN 3320). Similar to the male, differences: *Prosoma:* Chelicerae brown. Dorsal lateral spots darker than on males. Ocular region darker than on males. Spot around the fovea darker than on males. Clypeus with very maked long straight region, not trapezoidal. Sternum and endites darker than on males. *Legs:* femora, tibiae, metatarsi and tarsi paler than on males. *Epigynum:* Slightly wider than long (Figs 81, 82, 84). PP curved laterally; MSE with a marked Y-shaped upside down; long concavities sac-like between MSE and PP (Fig. 83). *Measurements:* Total length



FIGURES 72–84. *Ixchela simoni* (O. Pickard-Cambridge, 1898). Male: 72, Habitus, lateral view. 73, Carapace, dorsal view. 74, Chelicerae, frontal view. 75, Chelicera, lateral view. 76, Carapace, frontal view. 77, Bulb and procursus, dorsal view. 78–79, Left palp, retrolateral and prolateral views respectively. 80, Embolus, dorso-distal view (arrow indicates the sclerotized spine small and sub-distal on the embolus). Female: 81, Epigynum, frontal view. 82, Epigynum, ventral view. 83, Epigynum, dorsal view. 84, Epigynum, left lateral view. Scales: 1 mm (Figs 72–74, 76, 78, 79, 81–84), 0.5 mm (Figs 75, 77, 80).

7.70. Carapace 2.65 long, 2.45 wide. Clypeus 0.90 long. Diameter AME 0.12, ALE 0.25, PME 0.22, PLE 0.26. Distance 0.23, ALE-PME 0.18, PME-PME 0.27. Leg I: 36.60 (9.62+1.10+10.00+11.75+4.13), tibia II: 6.70, tibia III: 5.30, tibia IV: 6.87; tibia I l/d 22.85.

Variation. Females have carapace yellow paler than the males. The carapace and clypeus pattern are darker olive on females than males. Sternum and legs darker orange on males than females. Labium markedly darker in females than males. Male tibia I: 10.62, missing. Female tibia I: 10.00, missing.

Natural History. The specimens were collected on their sheet webs in an oak-pine forest (Fig. 4), among boulders and on walls along road-cuts in wet and shaded areas covered with roots (Figs 17, 18).

Distribution. *MEXICO: Guerrero* (O. Pickard-Cambridge 1898, F. O. Pickard-Cambridge 1902) (Fig. 85).

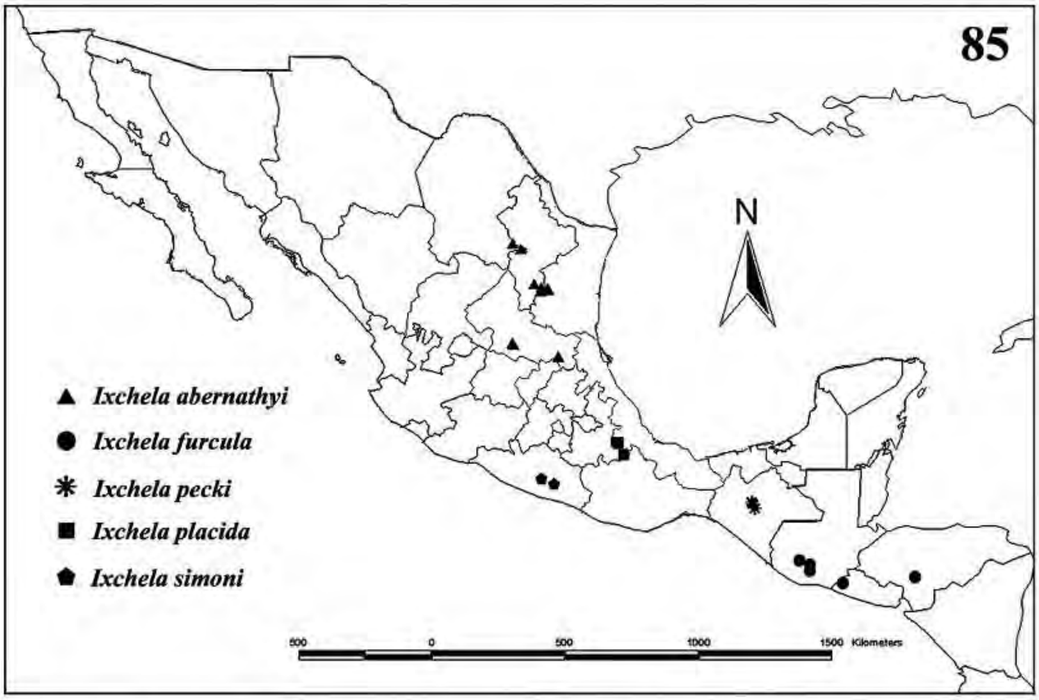


FIGURE 85. Known distribution of *Ixchela abernathyi* (Gertsch, 1971), *Ixchela furcula* (F. O. Pickard-Cambridge, 1902), *Ixchela pecki* (Gertsch, 1971), *Ixchela placida* (Gertsch, 1971) and *Ixchela simoni* (O. Pickard-Cambridge, 1898).

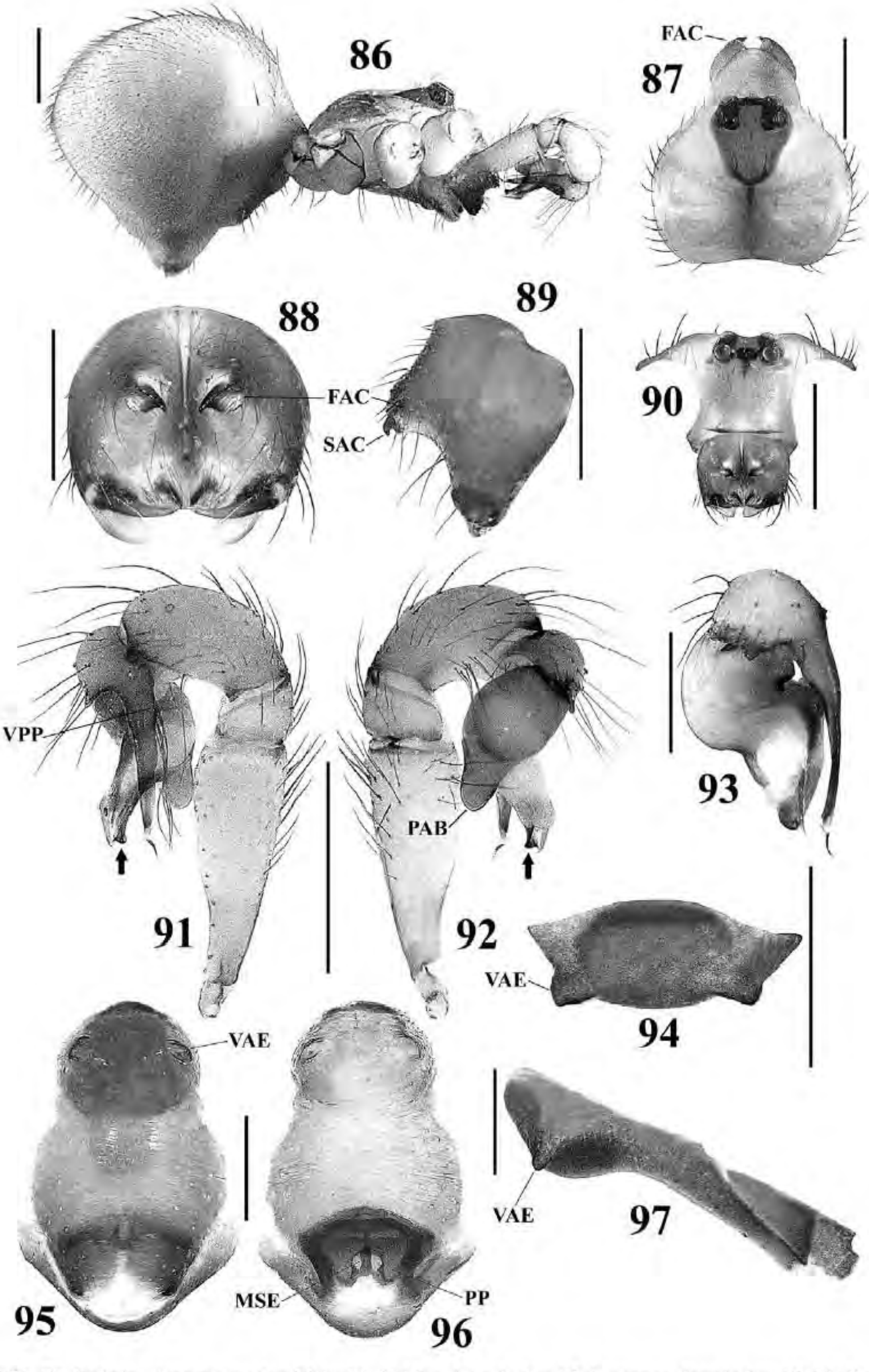
Ixchela mixe new species

Figures 86–97

Type data. *MEXICO: Oaxaca:* 1 ♂ holotype (CNAN T0399) [15 March 2008; A. Valdez, H. Montaño, C. Santibañez] from Cueva de Tlahuitoltepec (lat 17.0929°, lon -96.0547°; 2032 m), Municipio Santa María Tlahuitoltepec, Distrito Mixes; inside the cave. Paratypes: 1 ♀, 3 immatures (CNAN T0400) [20 July 2007; A. Valdez, O. Francke, H. Montaño, C. Santibáñez, A. Ballesteros], same locality as holotype. 1 ♂, 2 ♀♀ (one with egg sac) (CNAN T0623 and T0624) [14 September 2009; A. Valdez, C. Santibáñez, R. Paredes], same locality as holotype.

Etymology. The specific name is a noun in apposition and refers to the ethnic group of the region of Oaxaca where the type locality is located: Los Mixes.

Diagnosis. Resembles to *I. pecki*, distinguished by the FAC conical and larger, distally with SAC shorter and directed towards prolateral part of chelicerae (Figs 88–90); by palp femur without VAF (Figs 91, 92); by the distal sclerotized spine on the embolus, small and flat distally (arrows Figs 91, 92); by epigynum larger than wide, being wider in middle part (Figs 95, 96); and by VAE conical and shorter, separated from each other, located above anterior rounded protuberance (Figs 94, 95, 97).



FIGURES 86–97. *Ixchela mixe* **new species**. Male: 86, Habitus, lateral view. 87, Carapace, dorsal view. 88, Chelicerae, frontal view. 89, Chelicera, lateral view. 90, Carapace, frontal view. 91–92, Left palp, retrolateral and prolateral views respectively (arrows indicate the distal sclerotized spine on the embolus, small and flat distally). 93, Bulb and procursus, dorsal view. Female: 94, Epigynum, frontal view. 95, Epigynum, ventral view. 96, Epigynum, dorsal view. 97, Epigynum, left lateral view. Scales: 1 mm (86, 87, 90–92), 0.5 mm (88, 89, 93, 94–97).

Description. Male (Holotype). *Prosoma:* Carapace pale brown, with two anterior pale regions, next to ocular region (Fig. 87). Carapace with three thin pale gray lines, inconspicuous, extending from fovea to lateral margins (Fig. 87). Ocular region brown, with a thin, dark brown U-shaped region in posterior part (Fig. 87). Clypeus pale yellow, with wide brown region (Fig. 90). Chelicerae dark brown, distally pale (Fig. 88). Sternum pale olive green, darker anteriorly. Labium dark green, pale distally. Endites basally orange, olive green in middle part and pale distally. *Legs:* Coxae pale orange. Trochanters orange. Femora brown, dark on legs I and II, pale on legs III and IV. Patellae and tibiae pale brown. Metatarsi and tarsi orange. *Opisthosoma:* Pale blue, globular, higher than long (Fig. 86). *Palp:* Femur conical (Figs 91, 92). Procursus short, VPP inconspicuous and with long setae (Fig. 91). Procursus with distal spine thin and small (Figs 91–93). Embolus short, with long spine dorsal-apical (Figs 91, 92). *Measurements:* Total length 5.15. Carapace 2.25 long, 2.10 wide. Clypeus length 0.80. Diameter AME 0.09, ALE 0.20, PME 0.14, PLE 0.17. Distance ALE-PME 0.10, PME-PME 0.25. Leg I: 46.30 (12.40+0.90+12.20+16.50+4.30), tibia II: 8.70, tibia III: 7.10, tibia IV: 8.60. tibia I l/d 32.33.

Female (Paratype). (CNAN T0624). Similar to the male, differences: *Legs:* Femora brown, dark in basal part. Patellae, tibiae, metatarsi and tarsi pale brown. *Epigynum:* Larger than wide, brown on anterior and posterior parts, olive green in central part (Figs 94, 95). VAE anterior, short, conical (Figs 94, 95, 97). PP short, on posterior part of epigynum, with oval concavities sac-shaped between MSE and PP (Fig. 96). MSE short and wide, T-shaped (Fig. 96). *Measurements:* Total length 4.70. Carapace 2.00 long, 1.90 wide. Clypeus 0.75 long. Diameter of AME 0.06, ALE 0.18, PME 0.13, PLE 0.14. Distance ALE-PME 0.08, PME-PME 0.20. Leg I: 38.86 (10.38+0.83+10.00+ 13.75+3.90), tibia II: 7.40, tibia III: 6.10, tibia IV: 7.35; tibia I l/d 33.33.

Variation: There is variation in the shape of VAE, two females with VAE apically asymmetric; on another female VAE smaller, where even one of the two VAE in this is smaller than the other. Male tibia I: 12.20, 12.75. Female tibia I: 10.00–10.87 (x= 10.54).

Natural History. The spiders were collected inside the cave, on their sheet webs on walls, near the ground, and between boulders (Fig. 5). This cave was exceptionally small, with 20 m of total length, and located in a disturbed pine forest. The cave had low humidity, ca 50%, and also showed evidence of human disturbance inside.

Distribution. *MEXICO: Oaxaca* (Fig. 146).

Ixchela huberi new species

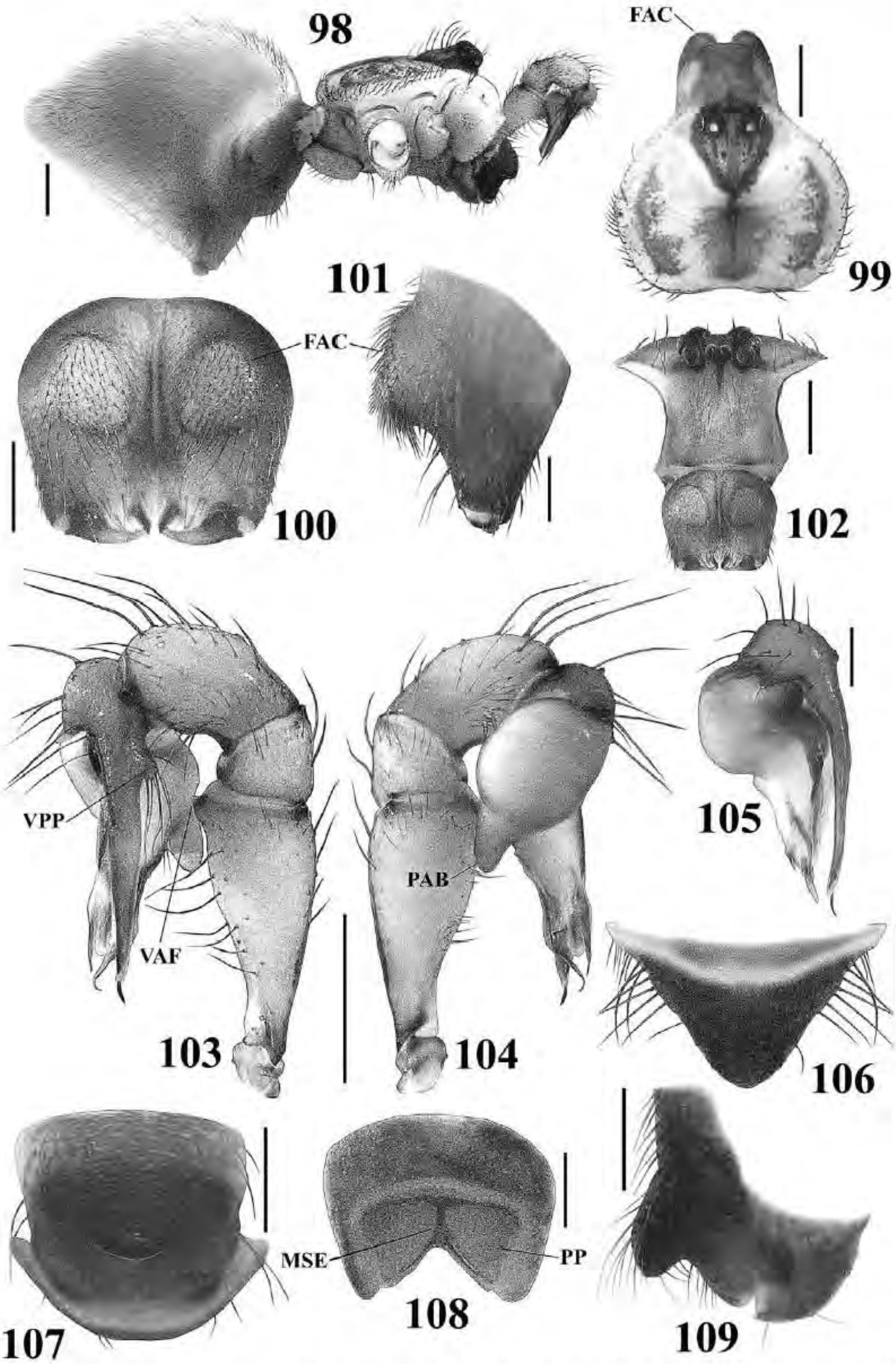
Figures 98–109

Type data. *MEXICO: Oaxaca:* 1 ♂ holotype (CNAN T0640) [3 December 2005; A. Valdez, O. Francke, H. Montaño, C. Santibáñez] from 3 km E of deviation to Santa Inés del Monte (lat 16.9407°, lon -96.8605°; 2665 m), Distrito Zaachila. Paratypes: 1 ♀ (CNAN T0641), same data as holotype. 2 ♂♂, 6 ♀♀ (one with egg sac), 4 immatures (CNAN T0642 to T0647) [19 September 2009; A. Valdez, C. Santibáñez, R. Paredes, J. A. Cruz] from Santa Inés del Monte (lat 16.9407°, lon -96.8604°; 2270 m), Distrito Zaachila.

Etymology. This species is dedicated to Dr. Bernhard A. Huber in recognition of his contribution to the knowledge of the family Pholcidae around the world, and by his comments and contribution in this work.

Diagnosis. Resembles to *I. simoni* and *I. huasteca*, distinguished from *I. simoni* by the FAC big and rounded in frontal view (Fig. 100), wider and apically flat in lateral view (Fig. 101); by the marginal spots on carapace less marked and wide (Fig. 99); by the darker region around the fovea, on *I simoni* is continuous from the posterior part of ocular region to posterior part of carapace (Fig. 73), on *I. huberi* is discontinuous between posterior part of the carapace and the fovea (Fig. 99); from *I. huasteca* by having FAC wider and shorter in lateral view (Fig. 101); and by the marginal spots on carapace more marked and wider (Fig. 99); from both species by the small epigynum, square-shaped ventrally (Fig. 107), with a ventral conical apophysis in middle part, small and with tip rounded (Figs 106, 107, 109).

Description. Male (Holotype). *Prosoma:* Carapace pale yellow, with paired long marginal brown spots (Fig. 99). Ocular region brown, with posterior region brown darker and Y-shaped. Fovea with irregular darker region around it, wide and brown (Fig. 99). Clypeus orange, with narrow pale brown longitudinal stripe, barely visible; with two brown spots near the chelicerae (Fig. 102). Chelicerae brown, pale in prolateral part, particulary in basal and distal parts (Fig. 100). Sternum orange, darker towards anterior part. Labium and endites brown, pale distally. Endites yellow in retrolateral part and on retrolateral aphophysis. *Legs:* Coxae pale orange. Trochanters brown.



FIGURES 98–109. *Ixchela huberi* **new species**. Male: 98, Habitus, lateral view. 99, Carapace, dorsal view. 100, Chelicerae, frontal view. 101, Chelicera, lateral view. 102, Carapace, frontal view. 103–104, Left palp, retrolateral and prolateral views respectively. 105, Bulb and procursus, dorsal view. Female: 106, Epigynum, frontal view. 107, Epigynum, ventral view. 108, Epigynum, dorsal view. 109, Epigynum, left lateral view. Scales: 1 mm (Figs 98, 99, 102–104), 0.5 mm (Figs 100, 101, 105–109).

Femora brown, paler basally. Patellae brown. Tibiae, metatarsi and tarsi orange. Distally on femora and basal and distally on tibiae with broad brown rings; rings of femora between two pale orange rings. *Opisthosoma:* Conical, larger than wide (Fig. 98). Gonopore plate larger than wide. *Palp:* Femur conical, slightly curved ventrally, with VAF ending in small conical tip (Fig. 103). Procursus long, wider in middle part; distally with small spine; conspicuous and rounded VPP with short setae, having the half of length of the procursus (Fig. 103). Embolus with distal-dorsal spine almost straight; projection distal-ventral distally curved (Figs 103, 104). *Measurements:* Total length 9.10. Carapace 3.45 long, 3.25 wide. Clypeus 1.37 long. Diameter AME 0.17, ALE 0.25, PME 0.21, PLE 0.26. Distance ALE-PME 0.22, PME-PME 0.38. Leg I: 46.98 (12.56+1.52+12.93+14.37+5.60), tibia II: 9.10, tibia III: 8.25, tibia IV: 11.00; tibia I l/d 21.55.

Female (Paratype). (CNAN T0641). Similar to the male, differences: *Epigynum:* Larger than wide, square (Figs 107, 108), with ventral apophysis on middle part (Figs 107, 109). PP wide, with concavities sac-shaped, large and inconspicuous, between PP and MSE (Fig. 108). *Measurements.* Total length 8.80. Carapace 3.00 long, 2.80 wide. Clypeus 1.15 long. Diameter AME 0.12, ALE 0.24, PME 0.15, PLE 0.20. Distance ALE-PME 0.19, PME-PME 0.35. Leg I: 42.63 (11.31+1.20+11.87+13.25+5.00), tibia II: 8.25, tibia III: 6.6, tibia IV: 8.0; tibia I l/d 21.59.

Variation. There is continuous variation in size within males and females. Male tibia I: 12.81–13.69 (x= 13.27). Female tibia I: 8.65–13.68 (x= 11.58).

Natural History. The type locality is located in oak-pine forest. The specimens were collected manually on irregular sheet webs on walls next to the road (Fig. 6), specifically in shaded and wetter areas covered with roots and litter (Figs 17, 18).

Distribution. *MEXICO: Oaxaca* (Fig. 146).

Ixchela juarezi new species

Figures 110–121

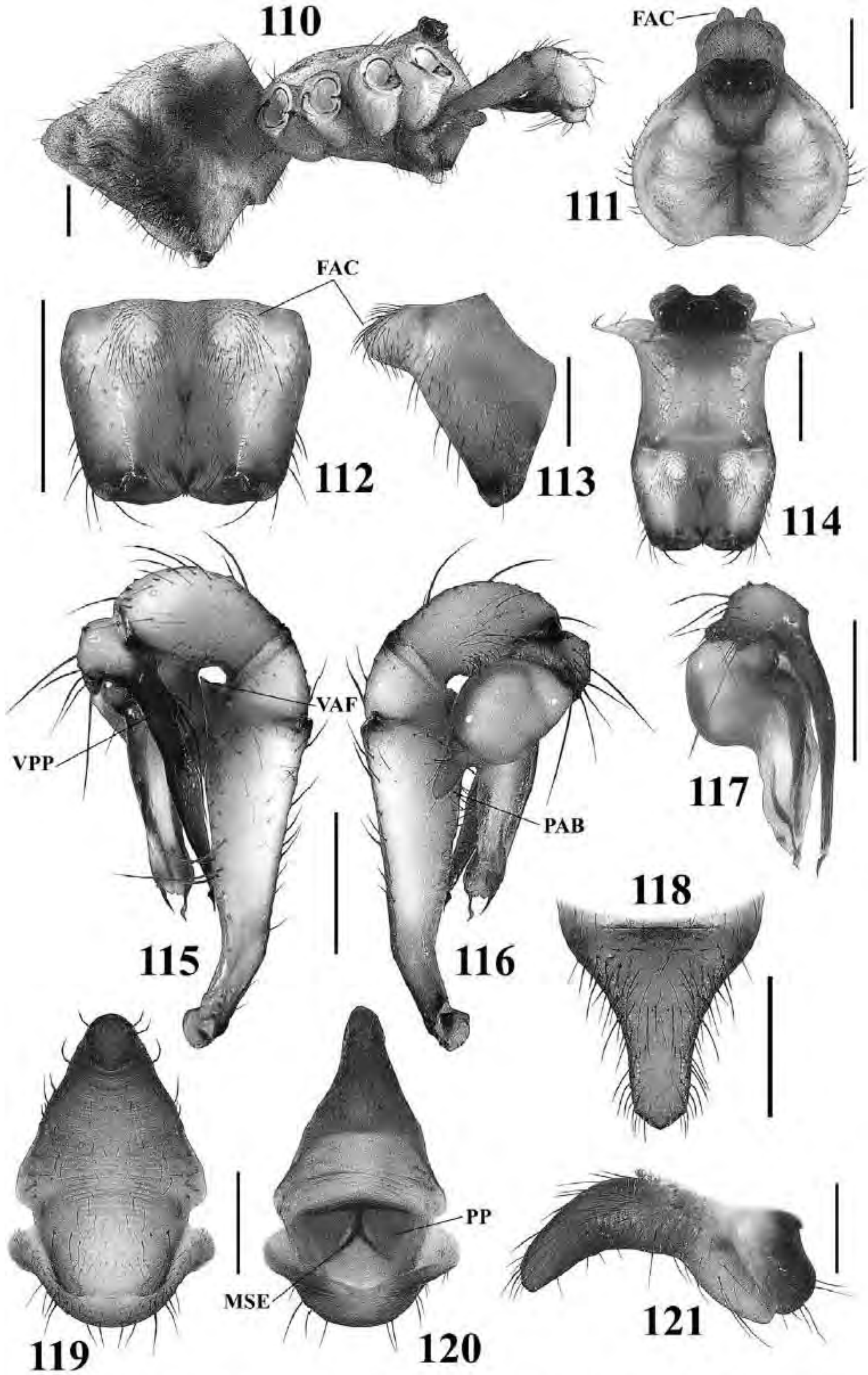
Type data. *MEXICO: Oaxaca:* 1 ♂ holotype (CNAN T0700) [22 April 2010; A. Valdez, C. Santibañez, J. Cruz, D. Barrales] from 2 km E of Guelatao (lat 17.3085°, lon -96.4881°; 1859 m), Municipio Guelatao, District Ixtlán de Juárez. Paratypes: 5 ♀♀ (CNAN T0701), same data as holotype. 1 ♂, 1 ♀ (CNAN T0702) [date?; A. L. Hernández] from Santa María Yahuiche, District Ixtlán de Juárez.

Other material examined. *MEXICO: Puebla:* 1 ♂ (CNAN 3632) [23 February 2012; A. Valdez, C. Santibáñez, J. Mendoza, D. Barrales, A. Ortega] from km 28 of deviation of highway Puebla-Tehuacan (lat 18.6029°, lon -97.4748°; 1985 m). 1 ♂, 2 ♀♀ (CNAN 3631) [24 February 2012; A. Valdez, C. Santibáñez, J. Mendoza, D. Barrales, A. Ortega] from 3 km E of Azumbilla, deviation to Nicolas Bravo (lat 18.6273°, lon -97.3710°; 2174 m), Municipio Nicolas Bravo.

Etymology. This species is dedicated to Benito Juárez García (1806–1872) in recognition of his role in the Mexican History; he was a Mexican lawyer and politician of Zapotec Indian origin and President of Mexico on several occasions, between 18 December 1857 and 18 July 1872. Born in Guelatao, municipality of the type locality of the species.

Diagnosis. Distinguished from congeners by the chelicerae with small, rounded and proximal FAC (Figs 112, 113); by chelicerae with central deep frontal concavity (Fig. 112); by the palp femur curved in proximal part (Figs 115, 116); by the PAB long, finger-shaped (Fig. 116); and by the epigynum with a very long apophysis, curved and conical (Figs 118–121).

Description. Male (Holotype). *Prosoma:* Carapace pale orange, with three small grey spots each side (Fig. 111). Ocular region brown, with a wide gray line on each side, near the fovea (Fig. 111). Deep fovea, with irregular grey spot surrounding it (Fig. 111). Clypeus pale orange (Fig. 114). Chelicerae brownish in retrolateral part, pale orange in frontal and prolateral parts; with inconspicuous SAC (Figs 112, 113). Sternum pale orange. Labium and endites orange, distally pale. *Legs:* Coxae pale orange. Trochanters brown. Legs brown, darker on femora than tibiae, metatarsi and tarsi. Femora distally with one ring brown, and one proximal ring and one distal on tibiae. *Opisthosoma:* Conical, larger than high, blue color (Fig. 110). Gonopore plate trapezoidal, wider than long. *Palp:* Femur conical, larger ventrally than dorsally, with VAF triangular (Fig. 115). Procursus long, almost straight, distally with triangular spine (Figs 115, 116). VPP oval with short setae (Fig. 115). Embolus with thin distal-dorsal spine, distal-ventral with sigmoidal projection (Figs 115, 116). *Measurements:* Total length 7.50. Carapace 3.45 long, 3.20 wide. Clypeus length 1.15. Diameter AME 0.13, ALE 0.26, PME 0.20, PLE 0.24. Distance ALE-PME 0.20, PME-PME 0.34. Leg I: 45.46 (12.12+1.35+12.00+14.62+5.37), tibia II: 8.70, tibia III: missing, tibia IV: 8.75; tibia I l/d 21.55.



FIGURES 110–121. *Ixchela juarezi* **new species**. Male: 110. Habitus, lateral view. 111. Carapace, dorsal view. 112. Chelicerae, frontal view. 113. Chelicera, lateral view. 114. Carapace, frontal view. 115–116. Left palp, retrolateral and prolateral views respectively. 117. Bulb and procursus, dorsal view. Female: 118. Epigynum, frontal view. 119. Epigynum, ventral view. 120. Epigynum, dorsal view. 121. Epigynum, left lateral view. Scales: 1 mm (Figs 110–112, 114–121), 0.5 mm (Fig. 113).

Female (Paratype). (CNAN T0701). Similar to the male, differences: *Prosoma:* Chelicerae brown, darker in retrolateral part. *Epigynum:* Larger than wide, conical and curved (Figs 119–121). PP triangular and in posterior part (Fig. 120), with concavities oval and with sac-shaped between MSE and PP (Fig. 120). MSE with Y-shape upside down (Fig. 120). *Measurements:* Total length 9.60. Carapace 3.60 long, 3.30 wide. Clypeus 1.33 long. Diameter AME 0.14, ALE 0.26, PME 0.22, PLE 0.26. Distance ALE-PME 0.22. PME-PME 0.34. Leg I: 46.65 (12.37+1.45+12.62+14.81+5.40), tibia II: 9.00, tibia III: 7.10, tibia IV: 9.37; tibia I l/d 22.88.

Variation. Male holotype smaller than the male paratype. Ocular region darker on males than on females. There is continuous variation in size among females. Male tibia I: 12.06, 14.00 ($\bar{x}$= 13.03). Female tibia I: 11.12–13.37 ($\bar{x}$= 12.46).

Natural History. The type specimens were collected in an oak-pine forest, on their sheet webs among boulders that formed a wall in the forest and under large fallen logs. These places were the spiders were collected had high humidity, ca 70%. Three females were collected with their egg sacs (Fig. 7); thus April and May appears to be the optional reproductive period for this species. The specimens of other material examined were collected in a thorny scrub forest, on their sheet webs among boulders and under dry leaves of agave plants, microhabitats which also have high humidity and are protected against the wind.

Distribution. *MEXICO: Oaxaca* (Fig. 146).

Ixchela grix new species

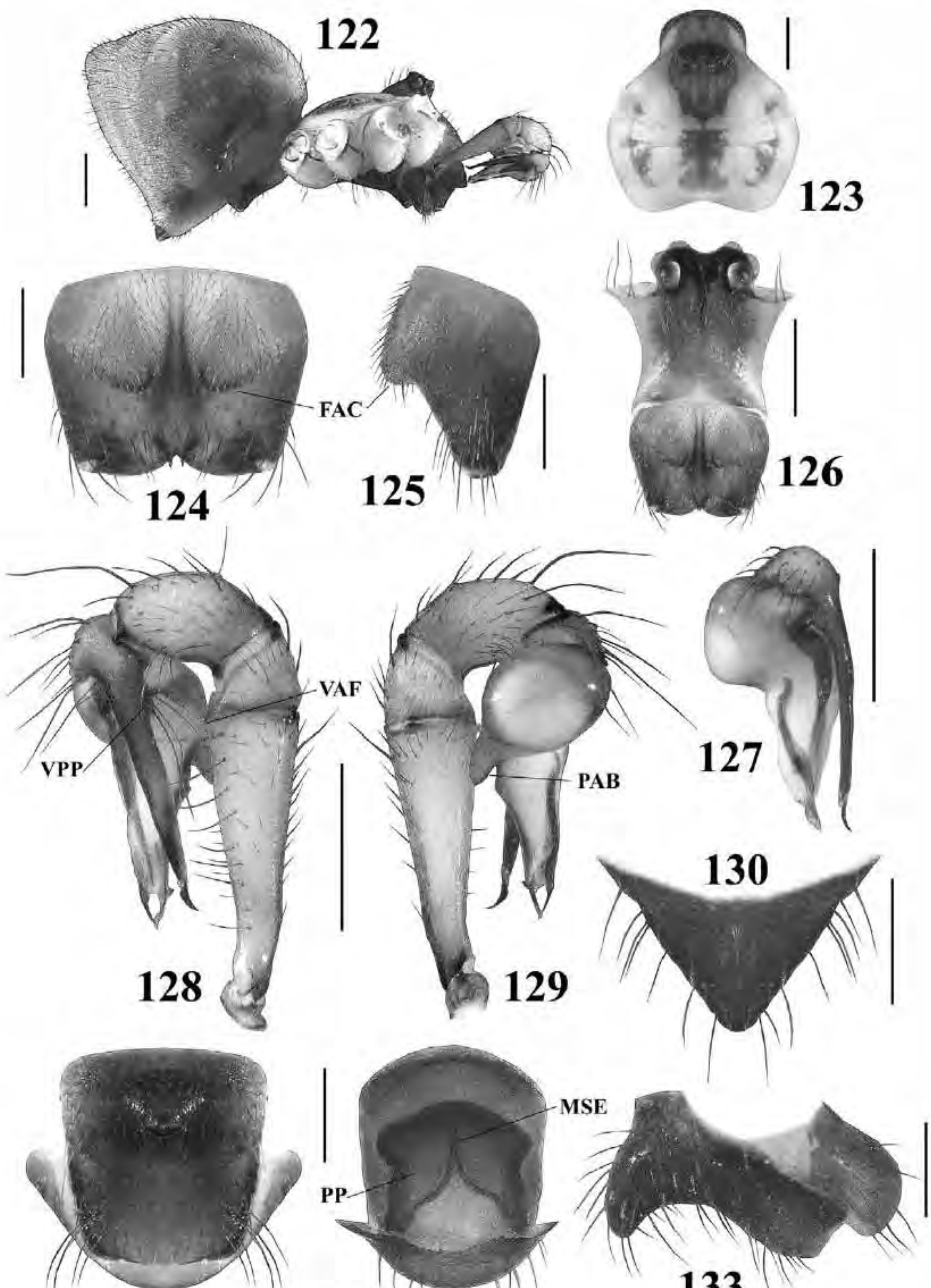
Figures 122–133

Type data. *MEXICO: Oaxaca:* 1 ♂ holotype (CNAN T0703) [3 May 2010; G. Montiel, M. Hernández, D. Barrales] from La Yerbabuena (lat 16.2666°, lon -97.3686°; 1710 m), Municipio Santa Catarina Juquila. Paratypes: 1 ♀ (CNAN T0704), same data as holotype. 1 ♀ (CNAN T0705) [1 May 2010; G. Montiel, M. Hernández, D. Barrales, R. Chavarría] from Ranchería La Yerbabuena (lat 16.2049°, lon -97.3569°; 1494 m), Municipio Santa Catarina Juquila.

Etymology. The specific name is a noun in apposition and dedicated to the acarologist and friend M. S. Griselda Montiel Parra "Grix" for her contribution to the knowledge of arachnids from Mexico and her participation in collecting the type series.

Diagnosis. Distinguished from congeners by the chelicerae with FAC rounded and small, directed toward prolateral part (Figs 124, 126); and by the epigynum with small apophysis, conical and curved (Figs 131, 133), square-shaped in ventral view (Fig. 131).

Description. Male (Holotype). *Prosoma:* Carapace beige, with two long pale grey spots, laterally, near to the margin (Fig. 123). Ocular region brown, with three inconspicuous lines projecting from posterior eyes to posterior part of the ocular region (Fig. 123). Fovea with irregular grey region around it, this region does not touch the posterior part of ocular region (Fig. 123). Clypeus pale yellow, with a wide longitudinal brown stripe, which has two lateral constrictions in middle part (Fig. 126). Chelicerae dark brown (Figs 124, 126). Sternum, labium and endites dark brown. *Legs:* Coxae pale yellow, orange on prolateral and retrolateral parts. Trochanters brown. Femora brown, paler basally, with a wide dark ring, sub-distally, conspicuous. Patellae dark gray. Tibiae, metatarsi and tarsi orange; tibiae with one basal conspicuous dark ring and one distal inconspicuous dark ring. *Opisthosoma:* Slightly conical, dark blue, as long as high (Fig 122). Gonopore plate olive, trapezoidal. *Palp:* Femur pale orange, conical and slender, VAF small and inconspicuous (Fig. 128). Patella and tibia orange. Procursus brown, conical, paler basally, with distal curved spine (Figs 128, 129). VPP inconspicuous, with long setae, distal setae becoming larger (Fig. 128). PAB long and slightly curved (Fig. 129). Embolus long and conical, with dorsal spine and ventral projection with same length, and touching each other (Figs 128, 129). *Measurements:* Total length 7.80. Carapace 3.40 long, 3.10 wide. Clypeus 1.25 long. Diameter AME 0.17, ALE 0.30, PME 0.24, PLE 0.26. Distance ALE-PME 0.22, PME-PME 0.36. Leg I: 58.44 (15.00+1.45+14.62+21.37+6.00), tibia II: 10.50, tibia III: missing, tibia IV: 10.62. Tibia I l/d: 23.40.



FIGURES 122–133. *Ixchela grix* **new species**. Male: 122, Habitus, lateral view. 123, Carapace, dorsal view. 124, Chelicerae, frontal view. 125, Chelicera, lateral view. 126, Carapace, frontal view. 127, Bulb and procursus, dorsal view. 128–129, Left palp, retrolateral and prolateral views respectively. Female: 130, Epigynum, frontal view. 131, Epigynum, ventral view. 132, Epigynum, dorsal view, 133, Epigynum, left lateral view. Scales: 1 mm (Figs 122, 123, 126–129), 0.5 mm (Figs 124, 125, 130–133).

Female (Paratype). (CNAN T0704). Similar to the male, differences: *Prosoma:* The two long pale grey spots on carapace wider than on male. The three inconspicuous lines projected from posterior eyes toward posterior part of the ocular region not visibles. The wide and brown longitudinal stripe on clypeus straight, without median constrictions. Chelicerae brown, paler on basal and frontal part. *Legs:* Coxae beige, brown on prolateral and retrolateral parts. Femora, tibiae, metatarsi and tarsi pale brown. Rings on distal part of femora, and rings on basal and distal of tibiae, more marked than on male. *Opisthosoma:* Larger than high, more conical than the male. *Epigynum:* Slightly larger than wide, square in ventral view (Fig. 131). PP larger than wide, with oval shape near to MSE (Fig. 132). MSE with upside down Y-shape, the two sac-shaped concavities between MSE and PP large and thin (Fig. 132). *Measurements.* Total length 7.80. Carapace 3.15 long, 2.95 wide. Clypeus 1.20 long. Diameter AME 0.16, ALE 0.28, PME 0.26, PLE 0.26. Distance ALE-PME 0.18, PME-PME 0.31. Leg I: 51.08 (12.75+1.35+13.50+17.68+5.80), tibia II: 9.37, tibia III: 7.30, tibia IV: 9.60; tibia I l/d 24.00.

Variation: Apophysis of the epigynum on one female more curved than the other. Tibia I: 13.25, 13.75.

Natural History. The specimens were collected manually on their irregular sheet webs on walls along road-cuts, in wet and shaded areas covered by roots and leaf-litter, within oak-pine forest.

Distribution. *MEXICO: Oaxaca* (Fig. 146).

Ixchela taxco new species

Figures 134–145

Type data. *MEXICO: Guerrero:* 1 ♂ holotype (CNAN T0710) [23 October 2010; A. Valdez, J. Cruz, G. Contreras, D. Barrales] from "Rancho La Soñadora", 6 km W of Taxco (lat 18.5614°, lon -99.6363°; 1994 m), Municipio Taxco de Alarcón. Paratypes: 1 ♀ (CNAN T0711), same data as holotype. 3 ♀♀, 3 immatures (CNAN T0712), same data as holotype. 2 ♂♂ (CNAN T0713) [9 December 2004; A. Valdez, H. Montáño] from Cueva Redonda, La Yerbabuena (lat 18.4383°, lon -99.9301°; 1900 m), Municipio Teloloapan.

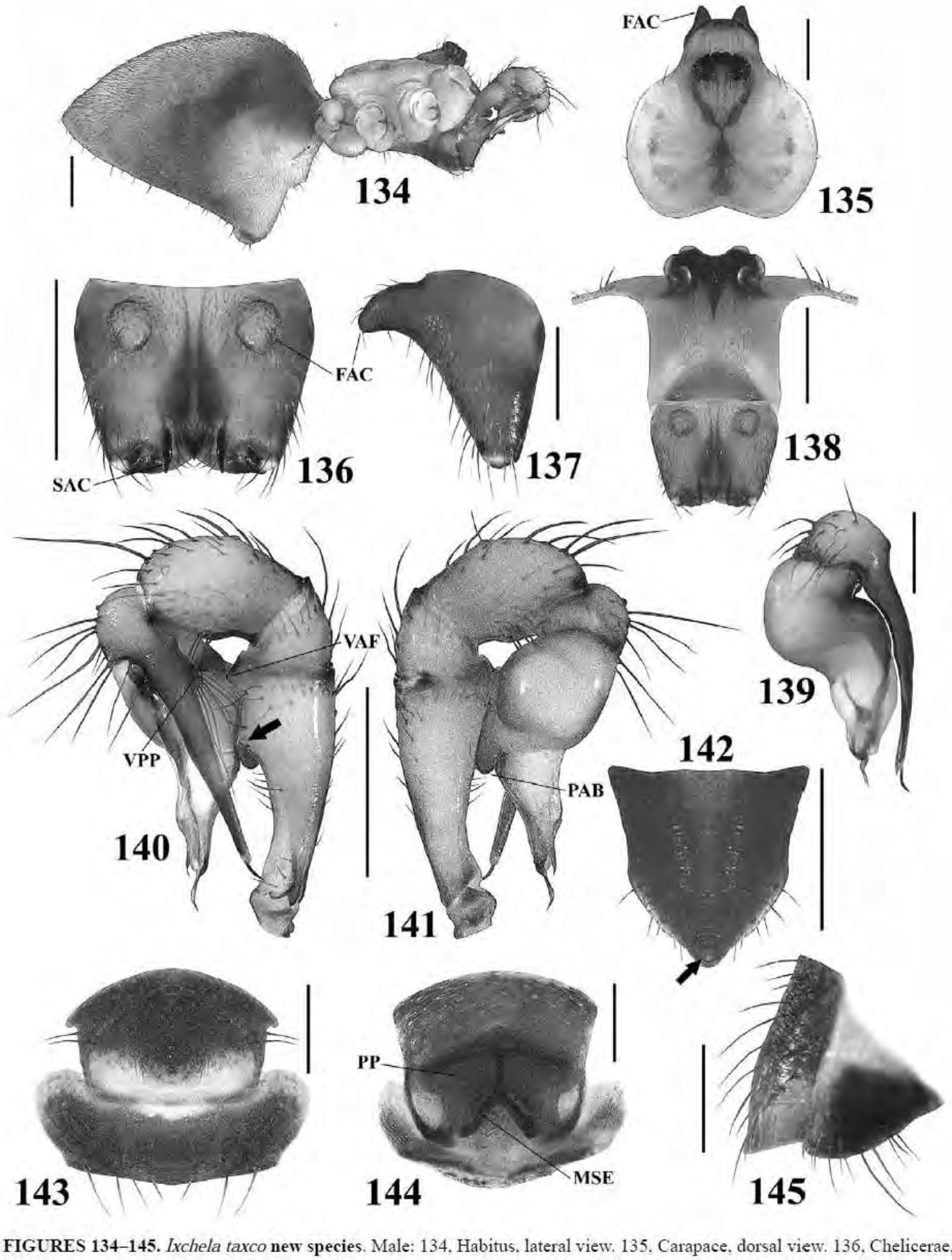
Other material examined. *MEXICO: Guerrero:* 1 ♀, 5 immatures (AMNH) [28 July 1956; W. Gertsch, V. Roth] from Taxco (lat 18.555985°, lon -99.604745°; 1773 m), Municipio Taxco de Alarcon.

Etymology. The specific name is a noun in apposition and refers to the municipality of the type locality: Taxco de Alarcón, Guerrero, Mexico.

Diagnosis. Easily distinguished from congeners by the chelicerae with FAC conical and curved, located in proximal part (Figs 136, 137); by the palp femur with ventral conical protuberance (arrow in Fig. 140); and by the epigynum higher than long, pentagonal in frontal view (Figs 142, 143, 145).

Description. Male (Holotype). *Prosoma:* Carapace pale yellow, with small and grey irregular spots, laterally near to the margin (Fig. 135). Ocular region dark grey, with two thin and long lines from anterior median eyes to posterior part of ocular region, two wide and short lines from posterior median eyes to posterior part of ocular region (Fig. 135). Fovea with a pale grey region surrounding it, arrow-shaped (Fig. 135). Clypeus with pale orange longitudinal region, darker distally (Fig. 138). Chelicerae brown on prolateral part, with SAC large (Fig. 136). Sternum pale yellow. Labium and endites brown, pale distally. *Legs:* Coxae pale yellow. Trochanters orange. Femora, tibiae, metatarsi and tarsi pale orange. Patellae brown. Legs with only one subdistal brown ring on femora, and one basal and one distal brown ring on tibiae. *Opisthosoma:* Conical, dark blue, larger than high (Fig. 134). Gonopore plate pale brown. *Palp:* Femur pale yellow, VAF conical and large (Fig. 140). Patella and tibia orange. Procursus brown, paller basally, with thin distal spine (Figs 140, 141). Embolus long and conical, dorsally with apical spine small, ventrally with apical projection large and curved (Figs 139–141). PAB rounded (Fig. 141). *Measurements:* Total length 7.90. Carapace 3.65 long, 3.30 wide. Clypeus 1.42 long. Diameter AME 0.14, ALE 0.28, PME 0.18, PLE 0.26. Distance ALE-PME 0.26, PME-PME 0.38. Leg I: 50.05 (13.62+1.50+13.75+15.43+5.75), tibia II: 10.81, tibia III: 8.90, tibia IV: 11.87. Tibia I l/d: 21.00.

Female (Paratype). (CNAN T0711). Similar to the male, differences: *Prosoma:* The grey irregular spots on carapace, more marked than on males. Irregular grey region around the fovea more marked than on males. Clypeus with brown region U-shaped. *Legs:* Coxae pale yellow, brown in prolateral and retrolateral parts. Femora, tibiae, metatarsi and tarsi orange. The rings on femora and tibiae more marked than on males. *Opisthosoma:* Darker blue than the males. *Epigynum:* Higher than long, conical in lateral view (Fig. 145), with small rounded pit (arrow Fig. 142). PP wide, curved laterally (Fig. 144). MSE with upside down Y-shaped, two concavities sac-shaped larger, between MSE and PP (Fig. 144). *Measurements.* Total length 9.30. Carapace 3.65 long, 3.20 wide. Clypeus 1.50 long. Diameter AME 0.15, ALE 0.26, PME 0.20, PLE 0.26. Distance ALE-PME 0.24, PME-PME 0.33. Leg I: 50.12 (13.37+1.15+13.90+16.00+5.70), tibia II: 10.43, tibia III: 8.75, tibia IV: 11.62; tibia I l/d 22.20.



FIGURES 134–145. *Ixchela taxco* **new species**. Male: 134, Habitus, lateral view. 135, Carapace, dorsal view. 136, Chelicerae, frontal view. 137, Chelicera, lateral view. 138, Carapace, frontal view. 139, Bulb and procursus, dorsal view. 140–141, Left palp, retrolateral and prolateral views respectively (arrow indicates the vetral protuberance on palp femur). Female: 142, Epigynum, frontal view (arrow indicates the small rounded pit). 143, Epigynum, ventral view. 144, Epigynum, dorsal view. 145, Epigynum, left lateral view. Scales: 1 mm (Figs 134–136, 138, 140–142), 0.5 mm (Figs 137, 139, 143–145).

Variation: There is variation in the size within females. The lateral spots on carapace of females more marked than on males, even can be arc-shaped. One female with legs darker orange than the others. One female with opisthosoma darker blue than the others. Male tibia I: 13.75–13.87 (x= 13.81). Female tibia I: 10.30–13.90 (x= 12.44).

Natural History. The specimens from "Rancho La Soñadora" were collected manually on their irregular sheet webs on walls along road-cuts within an oak-pine forest (Fig. 8); the male holotype was collected in a moist area, shaded and covered with roots and leaf-litter 30 cm blow ground level. The males paratype from Cueva Redonda, were collected about 10 m inside the cave on their sheet webs among boulders, the cave had humidity ca 70%. The cave is located in a disturbed oak forest.

Distribution. *MEXICO: Guerrero* (Fig. 146).

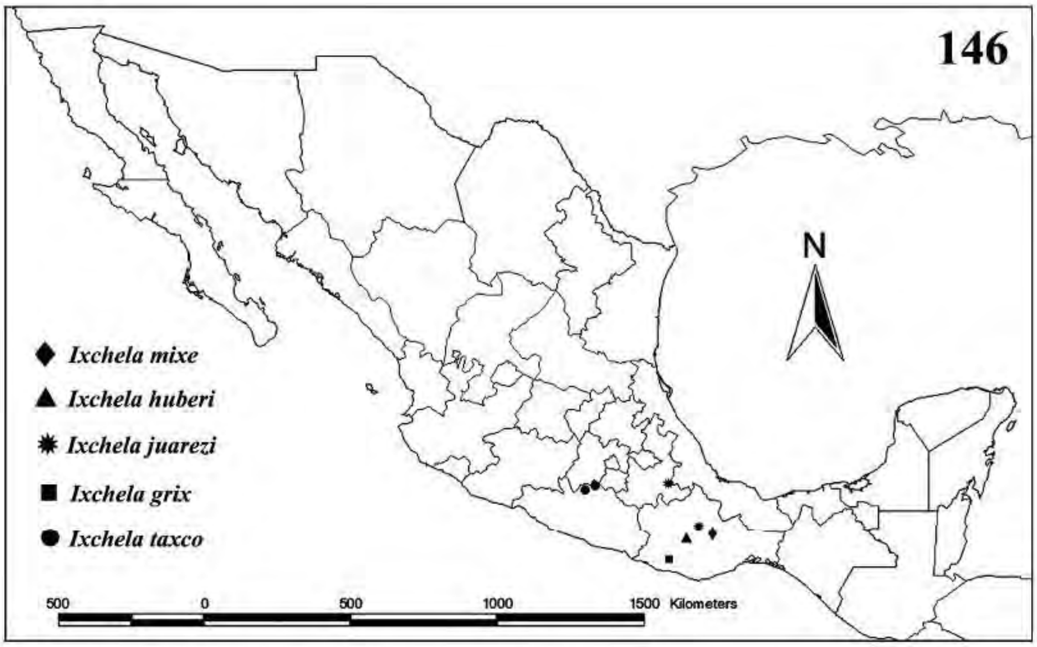


FIGURE 146. Known distribution of *Ixchela mixe* new species, *Ixchela huberi* new species, *Ixchela juarezi* new species, *Ixchela grix* new species and *Ixchela taxco* new species.

Ixchela franckei new species

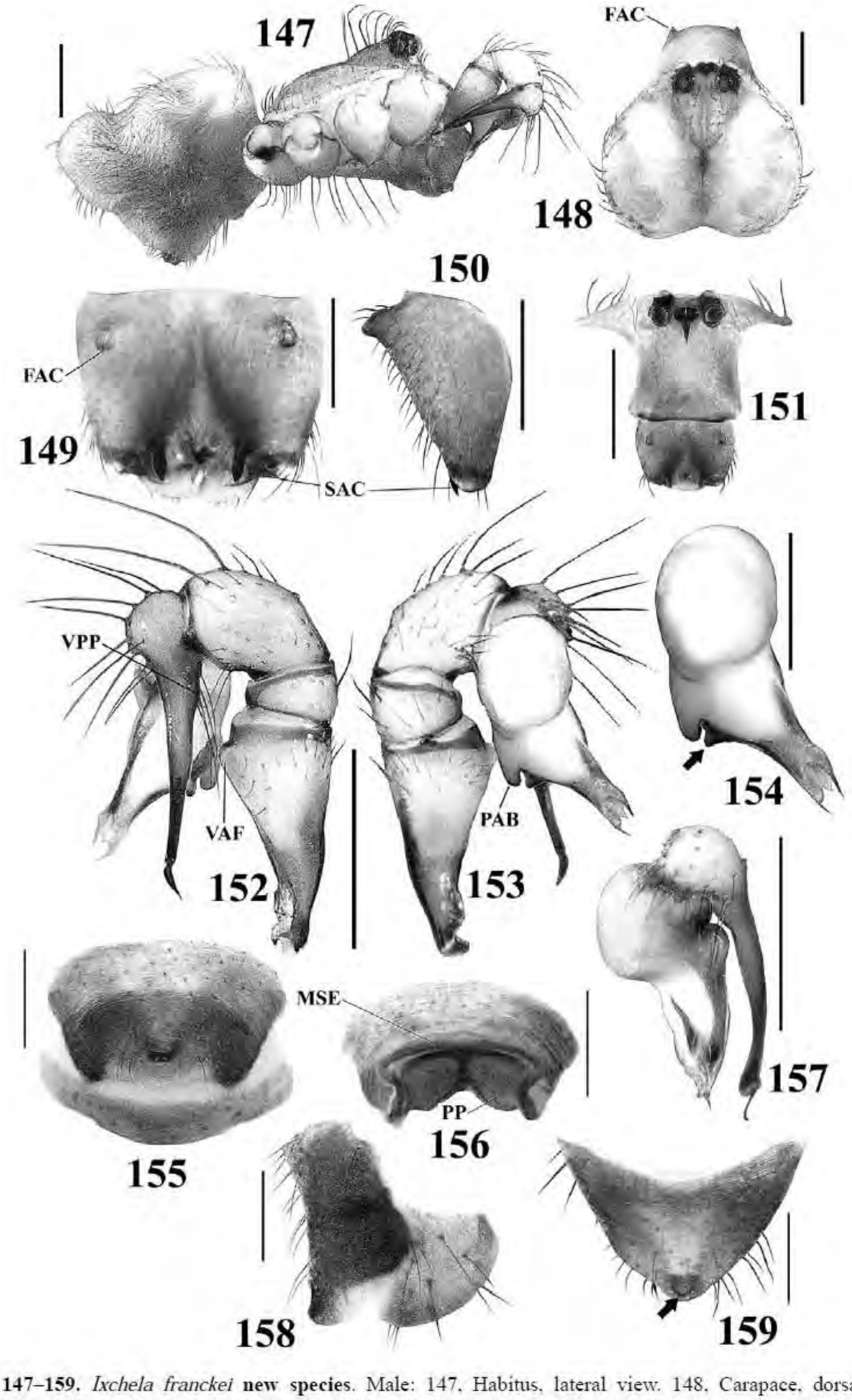
Figures 147–159

Type data. *MEXICO: Guerrero*: 1 ♂ holotype (CNAN T0715) [23 July 2009; A. Valdez, O. Francke, H. Montaño, C. Santibañez, T. Palafox, C. Quijano] from Cueva del Borrego, 3.5 km E of Omiltemi (lat 17.5559°, lon -99.6603°; 2623 m), Municipio Chilpancingo. Paratypes: 2 ♀♀ (CNAN T0716), 2 ♂♂ (CNAN T0717), 7 ♀♀ (CNAN T0718), same data as holotype.

Other material examined. *MEXICO: Guerrero*: 18 immatures (CNAN 3323), same data as holotype. 1 ♀, 9 immatures (CNAN 3324) [26 June 2007; O. Francke, H. Montaño, L. Escalante, A. Ballesteros], same locality as holotype. 3 ♂♂, 9 ♀♀, 2 immatures (CNAN 3325) [24 January 2012; A. Valdez, O. Francke, D. Ortiz, J. Mendoza, G. Contreras], same locality as holotype.

Etymology. This species is dedicated to Dr. Oscar F. Francke Ballvé in recognition of his contribution to the knowledge of the arachnids from Mexico and his support in this project.

Diagnosis. Resembles to *I. viquezi*, distinguished by FAC wider in lateral view (Figs 149, 150); by the SAC larger and wider (Figs 149, 151); by the embolus with proximal conical protuberance, ending in round tip and near to PAB (Figs 153, arrow 154); by the palp femur wide and short (Figs 152, 153); and by the small epigynum, with a half darker than the other half in ventral view (Fig. 155).



FIGURES 147–159. *Ixchela franckei* **new species**. Male: 147, Habitus, lateral view. 148, Carapace, dorsal view. 149, Chelicerae, frontal view. 150, Chelicera, lateral view. 151, Carapace, frontal view. 152–153, Left palp, retrolateral and prolateral views respectively. 154, Bulb and embolus, prolateral view (arrow indicates the round tip near to PAB). 157, Bulb and procursus, dorsal view. Female: 155, Epigynum, ventral view. 156, Epigynum, dorsal view. 158, Epigynum, left lateral view. 159, Epigynum, frontal view (arrow indicates the small rounded pit). Scales: 1 mm (Figs 147, 148, 151–153, 157), 0.5 mm (Figs 149, 150, 154–156, 158, 159).

Description. Male (Holotype). *Prosoma:* Carapace yellow, with inconspicuous orange spots towards each side of the margin of carapace (Fig. 148). Ocular region dark orange (Fig. 148). Fovea with irregular dark region around it, forming a pattern V-shaped with the posterior part of ocular region (Fig. 148). Ocular region with two gray lines, tenuous, longitudinal, close together (Fig. 148). Clypeus pale orange (Fig. 151). Chelicerae dark brown (Figs 149–151). Sternum pale orange, with brown region wide and dark. Labium dark brown. Endites dark brown, pale distally, with retrolateral apophysis slightly bifurcated. *Legs:* Coxae pale yellow, pale orange toward prolateral and retrolateral parts. Trochanters orange. Femora dark brown in basal third, pale orange towards distal half. Patellae gray. Tibiae pale orange. Metatarsi and tarsi dark orange. Tenuous single rings on distal part of femora and basal and distal part of tibiae. *Opisthosoma:* Globular, slightly larger than high, pale gray (Fig. 147). Gonopore plate wider than long, with half moon-shaped. *Palp:* Femur conical, with VAF rounded (Fig. 152). Procursus long, extending almost to the base of femur, with distal spine curved and wide (Figs 152, 153). VPP inconspicuous, with few and short setae (Fig. 152). Embolus short and wide, dorsally with thin distal spine; ventrally with thin distal projection spine-shaped (Figs 152–154). *Measurements:* Total length 6.10. Carapace 2.65 long, 2.55 wide. Clypeus 1.05 long. Diameter AME 0.12, ALE 0.23, PME 0.17, PLE 0.20. Distance ALE-PME 0.11, PME-PME 0.35. Leg I: 55.18 (14.44+1.0+14.06+19.88+5.8), tibia II: 11.05, tibia III: 9.40, tibia IV: missing. Tibia I l/d 46.86.

Female (Paratype). (CNAN T0716). Similar to the male, differences: *Legs:* Femora dark orange, without darker basal third. *Epigynum:* Wider than long (Figs 155, 156, 158). PP small, oval towards MSE (Fig. 156). Small rounded pit in ventral and frontal views (Figs 155, arrow 159). *Measurements:* Total length 7.00. Carapace 2.80 long, 2.55 wide. Clypeus 1.15 long. Diameter AME 0.11, ALE 0.23, PME 0.18, PLE 0.20. Distance ALE-PME 0.13, PME-PME 0.28. Leg I: 55.02 (14.50+1.16+14.50+19.56+5.30), tibia II: 10.00, tibia III: 8.25, tibia IV: 10.18; tibia I l/d 58.00.

Variation. Males and females have variation in size and coloration, but the variation in coloration could be because some of the specimens had recently molted. There is little variation on the epigyna, only one female had an epigynum smaller than the others. Male tibia I: 12.88–13.94 (x= 13.41). Female tibia I: 11.12–16.12 (x= 13.69).

Natural History. The vegetation type in the localities of the material examined is pine-oak forest. The specimens from Cueva del Borrego (Fig. 14) were collected in their irregular sheet webs, near the walls or in cracks on the walls (Fig. 9). Most of the specimens were collected among boulders on the ground. The cave had high humidity, ca 80%, and is located in the Morelos formation, a karst zone from the Cretaceous period. The specimen collected in pine-oak forest outside of the cave in Omiltemi was collected among fallen logs and boulders on the ground.

Distribution. *MÉXICO: Guerrero* (Fig. 214).

Ixchela tzotzil new species

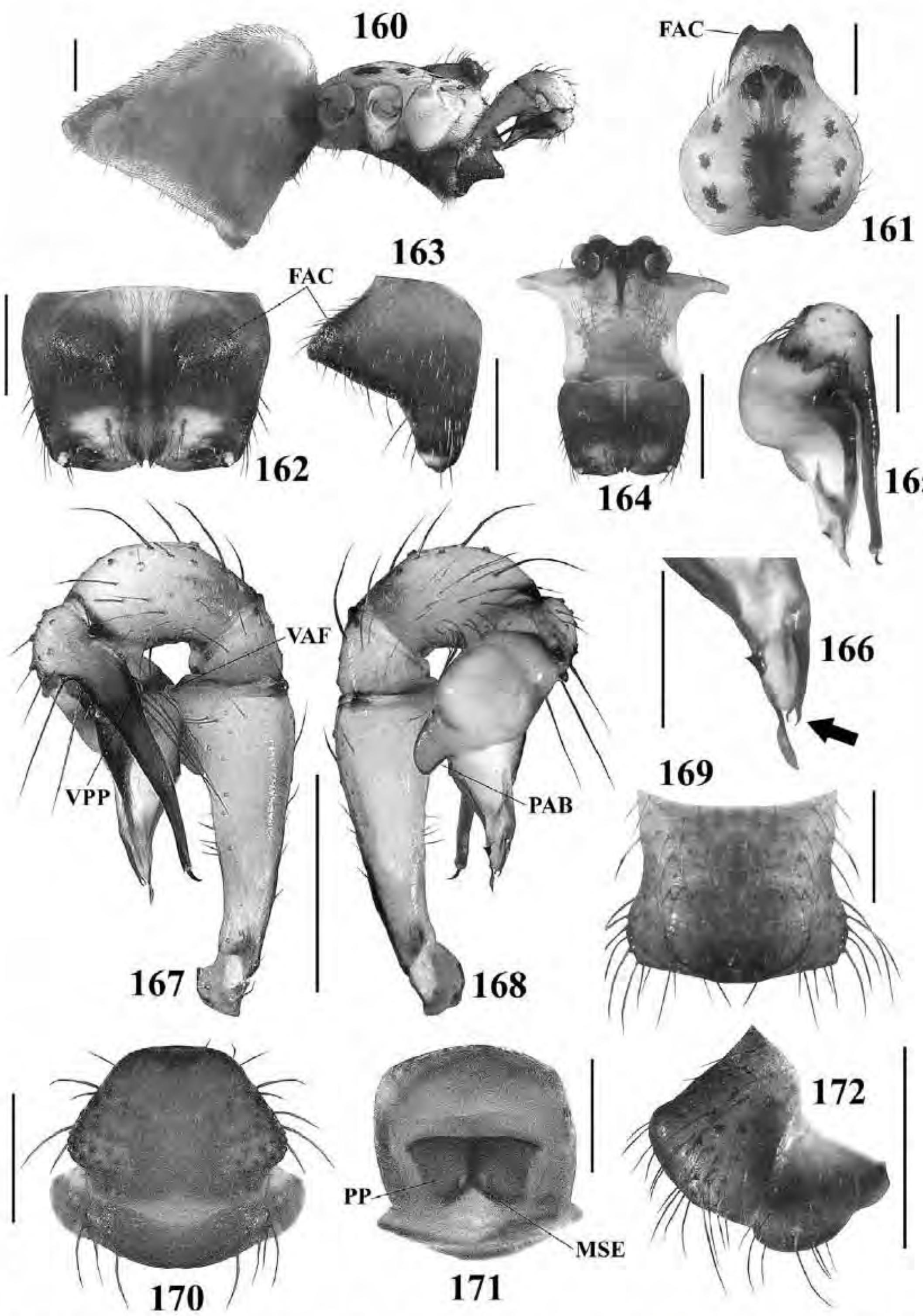
Figures 160–172

Type data. *MEXICO: Chiapas:* 1 ♂ holotype (CNAN T0728) [17 June 2011; A. Valdez, O. Francke, C. Santibáñez, J. Cruz, R. Monjaraz, G. Contreras, K. Zárate] from Grutas de Arcotete (lat 16.7254°, lon -92.5846°; 2323 m), Municipio San Cristóbal de las Casas. Paratypes: 1 ♀ (with ovisac) (CNAN T0729) [31 July 2010; D. Barrales, K. Zárate], same locality as holotype. 4 ♂♂, 3 ♀♀ (CNAN T0730), same data as holotype.

Other material examined. *MEXICO: Chiapas:* 4 ♂♂, 3 ♀♀, 3 immatures (CNAN 3326) [31 July 2010; D. Barrales, K. Zárate], same locality as holotype. 2 ♂♂, 1 ♀, 18 immatures (CNAN 3327), same data as holotype. 1 ♂, 21 immatures (CNAN 3548) [10 June 2010; K. Zárate, C. Pérez, E. Pérez], same locality as holotype. 1 ♀ (AMNH) [24 August 1966; J. Ivie, W. Ivie] from 8 km W of San Cristóbal de las Casas (lat 16.733329°, lon -92.714494°; 2420 m), Municipio San Cristóbal de las Casas.

Etymology. The specific name is a noun in apposition and refers to the main ethnic group: Los Tzotziles; that live in the Municipio San Cristóbal de las Casas, where the type locality is located.

Diagnosis. Resembles to *I. abernathyi*, distinguished by the chelicerae with FAC bigger (Figs 162, 163); by the SAC inconspicuous (Fig. 162); and by the epigynum with central apex wider in frontal view (Fig. 169), and by the trapezoidal shape in ventral view (Fig. 170).



FIGURES 160–172. *Ixchela tzotzil* **new species**. Male: 160, Habitus, lateral view. 161, Carapace, dorsal view. 162, Chelicerae, frontal view. 163, Chelicera, lateral view. 164, Carapace, frontal view. 165, Bulb and procursus, dorsal view. 166, Embolus, prolaterodorsal view (arrow indicates the bifurcated spine). 167–168, Left palp, retrolateral and prolateral views respectively. Female: 169, Epigynum, frontal view. 170, Epigynum, ventral view. 171, Epigynum, dorsal view. 172, Epigynum, left lateral view. Scales: 1 mm (Figs 160, 161, 164, 167, 168, 172), 0.5 mm (Figs 162, 163, 165, 169–171), 0.25 mm (Fig. 166).

Description. Male (Holotype). *Prosoma:* Pale yellow, with three brown spots each side (Fig. 161). Ocular region orange, with a wide brown line in the middle (Fig. 161). Fovea with a wide brown region surrounding it and extending backward (Fig. 161). Clypeus pale orange, with a wide longitudinal grey region (Fig. 164). Chelicerae brown (Figs 162, 163). Sternum orange, with several small grey spots, particulary at the base of the setae. Labium and endites brown, pale distally. Endites with retrolateral apophysis slightly bifurcated. *Legs:* Coxae pale yellow, trochanters brown. Femora dark orange, with several brown rings throughout its length; one sub-distal ring, wide and very marked. Patellae brown. Tibiae orange with several brown rings throughout its length, less marked than on femora (Fig. 12). Metatarsi and tarsi orange, without rings. *Opisthosoma:* Conical, larger than high, pale grey (Fig. 160). Gonopore plate hexagonal. *Palp:* Femur conical, pale orange, paler ventrally, with VAF conical (Fig. 167). Patellae and tibia orange. Procursus brown, paler basally, long and slightly curved, with distal spine small and curved (Fig. 167). VPP inconspicuous, with few and large setae (Fig. 167). Embolus conical, dorsally with bifurcated spine (arrow Fig. 166); ventrally with apical large projection (Figs 166–168). PAB wide (Fig. 168). *Measurements:* Total length 7.20. Carapace 2.90 long, 2.65 wide. Clypeus 1.10 long. Diameter AME 0.13, ALE 0.22, PME 0.18, PLE 0.24. Distance ALE-PME 0.16, PME-PME 0.25. Leg I: 49.45 (13.31+1.20+13.37+16.87+4.70), tibia II: 9.50, tibia III: 8.60, tibia IV: 11.25. Tibia I l/d: 30.42.

Female (Paratype). (CNAN T0729). Similar to the male, differences: *Prosoma:* Paler yellow than on male. Ocular region orange, paler than on male, with one thin line from each posterior eye toward posterior region. Brown longitudinal pattern on the clypeus. *Legs:* Femora, tibiae, metatarsi and tarsi paler orange than the male. *Epigynum:* Wider than long (Figs 170, 172). PP wide, with two oval concavities sac-shaped between MSE and PP. MSE with upside down Y-shape (Fig. 171). *Measurements:* Total length 7.50. Carapace 2.70 long, 2.60 wide. Clypeus 1.00 long. Diameter AME 0.14, ALE 0.20, PME 0.18, PLE 0.22. Distance ALE-PME 0.19, PME-PME 0.25. Leg I: missing, tibia II: 9.00, tibia III: 6.60, tibia IV: 8.50; tibia I l/d missing.

Variation. Males and females with variation in the color of dorsal spots on carapace and on the region around the fovea, in some specimens darker brown than on others. There is variation in the number of rings on the legs in both sexes, 5–9 rings on femora and 4–8 on tibia, femur I has more rings than the others. Male tibia I: 9.75–13.37 (x= 11.37). Female tibia I: 8.70–8.80 (x= 8.75).

Natural History. Most specimens were collected inside the cave on their irregular sheet webs, in cracks between walls or between karstic formations (stalactites, stalagmites and columns). Some specimens were collected outside the cave, in an oak-pine forest, under fallen logs and boulders (Fig. 12). *Ixchela tzotzil* new species was collected around the type locality of *I. pecki*, Grutas de Arcotete, Chiapas; although specimens of *I. pecki* were not collected at this locality during this study, the two species might be considered sympatric. *Ixchela pecki* was collected 30 km SE of Grutas de Arcotete, inside the Cueva de Teopisca, Chiapas. Both species are easily distinguished morphologically (Figs 47–59, 160–172), as well as by molecular data (*in prep.*).

Distribution. *MEXICO: Chiapas* (Fig. 214).

Ixchela santibanezi new species

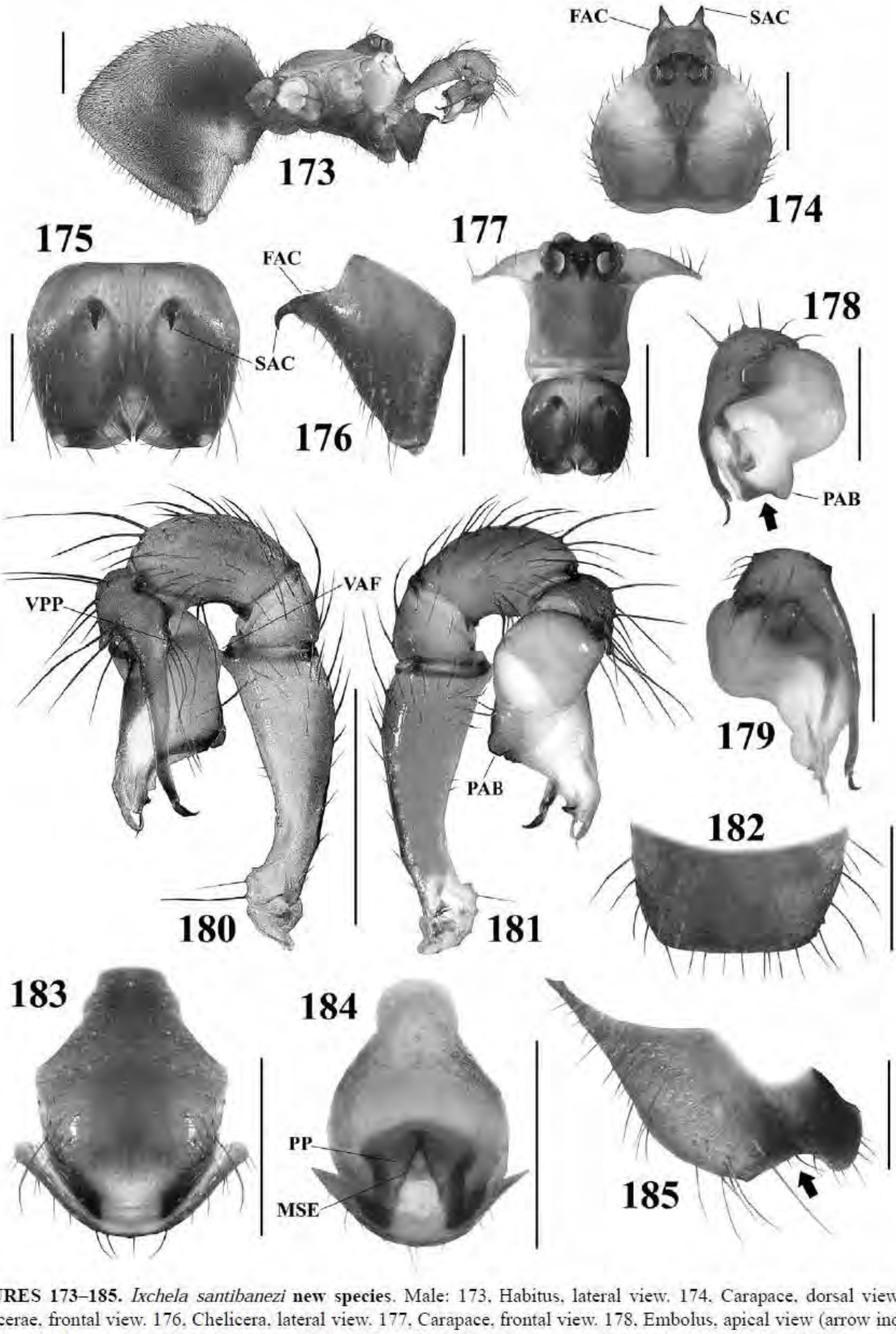
Figures 173–185

Type data. *MEXICO: Chiapas:* 1 ♂ holotype (CNAN T0075), 1 ♀ paratype (CNAN T0076) [19 June 2011; A. Valdez, O. Francke, C. Santibáñez, J. Cruz, R. Monjaraz, G. Contreras, K. Zárate] from outside of Cueva de las Abejas (lat 16.8487°, lon -93.2432°; 1190 m), Municipio San Fernando.

Etymology. This species is dedicated to the scorpionologist and friend Carlos E. Santibáñez López ("La Tortuga"), for his contribution to the knowledge of arachnids from Mexico, and his participation in collecting the type series.

Diagnosis. Resembles to *I. furcula*, distinguished by the FAC with SAC apically, long and hook-shaped (Figs 175, 176); by the PAB smaller, inconspicuous (Figs 178, 181); by the epigynum pear-shaped in ventral view (Fig. 183), with posterior concavity in lateral view (arrow, Fig. 185).

Description. Male (Holotype). *Prosoma:* Carapace orange, paler near the ocular region, without spots, only a dark region on each side on posterior part, and a grey triangular pattern behind the fovea (Fig. 174). Fovea with irregular pattern thin and grey surrounding it, with a reddish pattern U-shaped on posterior part of ocular region (Fig. 174). Ocular region brown, without lines (Fig. 174). Clypeus with a longitudinal region wide and brown (Fig. 177).



FIGURES 173–185. *Ixchela santibanezi* **new species**. Male: 173, Habitus, lateral view. 174, Carapace, dorsal view. 175, Chelicerae, frontal view. 176, Chelicera, lateral view. 177, Carapace, frontal view. 178, Embolus, apical view (arrow indicates the concavity between basal protuberance and the PAB). 179, Bulb and procursus, dorsal view. 180–181, Left palp, retrolateral and prolateral views respectively. Female: 182, Epigynum, frontal view. 183, Epigynum, ventral view. 184, Epigynum, dorsal view. 185, Epigynum, left lateral view (arrow indicates posterior concavity). Scales: 1 mm (Figs 173, 174, 177, 180, 181, 183, 184), 0.5 mm (Figs 175, 176, 178, 179, 182, 185).

In frontal view, chelicerae brown, paler frontally, pale basally above FAC and with a small pale region below FAC (Fig. 175). Chelicerae with SAC (Figs 175, 176). Sternum olive, without lines or spots. Labium and endites olive, pale distally, endites with pale retrolateral apophysis. *Legs:* Coxae and trochanters orange. Femora brown, paler basally; without rings, only one inconspicuous ring distally. Tibiae pale brown, with two inconspicuous rings, one basal and another subdistal. Metatarsi and tarsi pale brown. *Opisthosoma:* Subconical, dark blue, as long as high (Fig. 173). Plate of genital gonopore pale green, wider than long. *Palp:* Femur conical and curved, olive dorsally becoming paler ventrally, with conical VAF (Figs 180, 181). Basal apophysis on retrolateral position of the femur long and square-shaped (Fig. 180). Patella and tibia olive. Procursus brown, becoming olive basally, slightly curved distally; with wide and curved spine (Figs 179–181). Embolus with large spine dorsal-distal, ventrally with projection thin (Figs 180, 181). Embolus with a basal protuberance ending in round tip, forming a concavity between it and the PAB (arrow, Fig. 178). *Measurements:* Total length 5.40. Carapace 2.25 long, 2.20 wide. Clypeus 0.85 long. Diameter AME 0.10, ALE 0.24, PME 0.17, PLE 0.22. Distance ALE-PME 0.10, PME-PME 0.18. Leg I: 41.14 (11.37+0.90+11.00+14.37+3.50), tibia II: 8.20, tibia III: 6.62, tibia IV: 8.37; tibia I l/d 29.66.

Female (Paratype). Similar to the male, differences: *Prosoma:* Carapace pale orange, with marginal pattern and triangular pattern behind the fovea more visible than on male. Irregular grey pattern around the fovea darker than on male. Ocular region and longitudinal region of clypeus darker brown than on male. Chelicerae paler brown than on male. Sternum, labium and endites darker olive than on male. *Legs:* Femora, tibiae, metatarsi and tarsi paler brown than on male. *Epigynum:* Larger than wide (Figs 183, 185), with square-shaped in frontal view (Fig. 182). PP triangular, without the two concavities sac-shaped between MSE and PP; MSE with V-shaped upside down (Fig. 184). *Measurements:* Total length 5.10. Carapace 2.15 long, 1.97 wide. Clypeus 0.77 long. Diameter AME 0.08, ALE 0.22, PME 0.16, PLE 0.20. Distance ALE-PME 0.10, PME-PME 0.18. Leg I: missing, tibia II: 6.35, tibia III: 5.30, tibia IV: 6.65; tibia I l/d missing.

Natural History. The specimens were collected outside of the Cueva de las Abejas under fallen logs, in a tropical rain forest, with humidity ca 80%.

Distribution. *MEXICO: Chiapas* (Fig. 214).

Ixchela huasteca new species

Figures 186–201

Type data. *MEXICO: San Luis Potosí:* 1 ♂ holotype (CNAN T0077) [6 May 2011; A. Valdez, O. Francke, J. Cruz, R. Monjaraz, G. Contreras] from Buenavista, near Ahuacatlan (lat 21.3406°, lon -99.0986°; 1700 m), Municipio Xilitla. Paratypes: 1 ♀ (CNAN T0078), same data as holotype. *Querétaro:* 2 ♂♂ (CNAN T0079) [14 November 2009; A. Valdez, O. Francke, C. Santibáñez, J. Cruz] from 1.5 km road to Microwave Station La Pingüica (lat 21.1253°, lon -99.6762°; 2680 m), Municipio Pinal de Amoles. 1 ♂, 2 ♀♀, 2 immatures (CNAN T0080) [15 November 2009; A. Valdez, O. Francke, C. Santibáñez, J. Cruz] from 200 m E of junction road Pinal de Amoles-Bucarelli (lat 21.1257°, lon -99.6391°; 2544 m), Municipio Pinal de Amoles.

Other material examined. *MEXICO: Hidalgo:* 2 ♀♀ (CNAN 3628) [7 November 2010; A. Valdez, O. Francke, J. Cruz, C. Santibáñez, E. Miranda] from "El Salto" (lat 20.9017°, lon -99.2147°; 2025 m), Municipio Jacala de Ledezma. 2 ♂♂, 1 ♀ (with egg sac) (AMNH) [20 July 1956; V. Roth, W. Gertsch] from 16 km S of Jacala, Municipio Jacala. 1 ♀ (with egg sac), 1 immature (AMNH) [8 November 1966; J. Reddell, J. Fish] from Cueva de Puerto de la Zorra. *Querétaro:* 1 immature (CNAN 3627) [16 April 2009; R. Paredes] from Cueva del Judío (lat 21.1217°, lon -99.6284°; 2594 m), Municipio Pinal de Amoles. 1 ♂ (CNAN 3629) [14 November 2009; A. Valdez, O. Francke, C. Santibáñez, J. Cruz] from Puerto Tejamanil (lat 21.1225°, lon -99.6536°; 2554 m), Municipio Pinal de Amoles. 1 ♀ (CNAN 3630) [11 June 2005; P. Sprouse] from Sotano de la Culebra, Sta Monica de las Tinajas (lat 21.0573°, lon -99.4002°; 1751 m), Municipio San Joaquín. 1 ♀ (AMNH) [26 November 1977; R. Jamenson] from Sotano of Herreras, San Joaquin (lat 20.8972°, lon -99.5752°, 2466 m), Municipio San Joaquín. 1 ♀ (AMNH) [21 November 1977; R. Jameson] from Cueva del Rincon, Lagunita, El Doctor (lat 20.8497°, -99.5851°; 2743 m), Municipio Cadereyta. 1 ♀ (with egg sac) (AMNH) [June 1972; W. Russell] from Sotano del Pino #6, 20 km NNE of Pinal de Amoles. 1 ♀ (AMNH) [9 July 1967; J. Reddell] from Sotano de la Lagunita, 1.6 km E of Río Blanco (lat 21.2093°, lon -99.7242°; 2050 m), Municipio Peñamiller. 1 immature (AMNH) [9 July 1967; J. Reddell, J. Fish, P. Russell] from Cueva del Puerto del León, 6.5 km SE of Río Blanco (lat 21.1672°, lon -99.6971°; 2947 m), Municipio Peñamiller. 1 ♀, 1 immature (AMNH) [8 September 1966; D. McKenzie, J.

Reddell] from Cueva de Tejamanil. 1 ♀ (AMNH) [11 July 1967; J. Fish] from Sotano del Tigre, 24 km SW of Jalpan (lat 21.0624°, lon -99.6479°; 1720 m), Municipio Peñamiller. 1 ♀ (AMNH) [17 July 1969; S. Peck] from Iron mine at road, 2 km E of Pinal de Amoles, Municipio Pinal de Amoles. *San Luis Potosí:* 1 ♂, 1 ♀, 2 immatures (CNAN 3625) [23 September 1960; Bolívar, Medellín, Gómez, Vázquez] from Gruta de la Catedral (1600 m), Municipio Río Verde. 1 ♂ (CNAN 3626) [18 November 2007; P. Sprouse] from Xilitla, Viejo Miramar (lat 21.3918°, lon -99.0491°; 1496 m), Municipio Xilitla.

Etymology. The specific name is a noun in apposition and refers to ethnic and cultural region encompassing several states of Mexico named *Huasteca*, from North of Veracruz, South of Tamaulipas, Sierra Gorda of Querétaro, some places of Puebla and some parts of the states Hidalgo and San Luis Potosi, in this last state is located the type locality.

Diagnosis. Resembles to *I. simoni*, distinguished by the FAC larger and rounded distally (Figs 189, 190); by the carapace with a marginal pattern arc-shaped on each side, on distal middle part (Fig. 187); and by the epigynum with apophysis wider (Figs 198, 201), in frontal view with rounded lateral corners (Figs 194, 195).

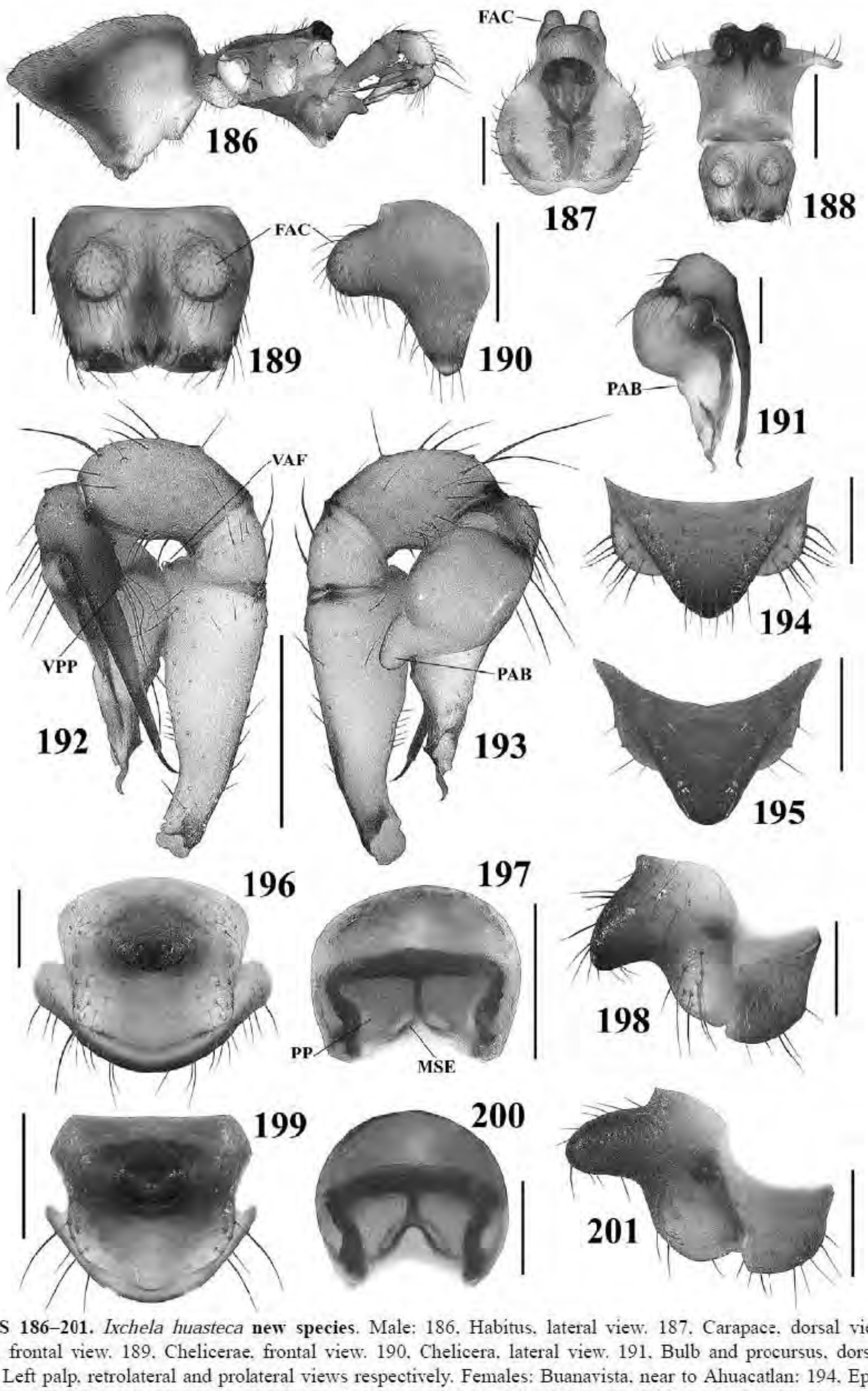
Description. Male (Holotype). *Prosoma:* Pale yellow. Ocular region orange, with one grey longitudinal line, and one small grey line behind each PME (Fig. 187). Fovea with wide grey region surrounding it, from poterior part of ocular region to posterior part of carapace (Fig. 187). Clypeus pale yellow, with inconspicuous brown longitudinal region, becoming darker distally (Fig. 188). Chelicerae orange, paler on FAC (Fig. 189). Chelicerae with SAC inconspicuous (Fig. 189). Sternum yellow, with small brown region anteriorly. Labium and endites brown, becoming pale on retrolateral apophysis of endites. *Legs:* Coxae beige. Trochanters brown. Femora pale orange, darker basally in femur I, with one sub-distal ring very marked. Patellae grey, paler basally. Tibiae orange with two grey rings, one basal and another sub-distal. Metatarsi and tarsi dark orange. *Opisthosoma:* Conical, larger than high (Fig. 186). Plate of genital gonopore pale grey, oval-shaped. *Palp:* Femur conical and wide, pale orange, becoming paler ventrally; with VAF wide, ending in small tip (Fig. 192). Patellae and tibiae pale orange. Procursus straight, brown, dark orange basally, with distal spine curved (Figs 192, 193). VPP rounded, with few and large setae (Fig. 192). Embolus dorsally with reduced spine, ventrally long and curved projection (Figs 192, 193). *Measurements:* Total length 6.20. Carapace 2.45 long, 2.15 wide. Clypeus 0.95 long. Diameter AME 0.12, ALE 0.22, PME 0.18, PLE 0.22. Distance ALE-PME 0.15, PME-PME 0.27. Leg I: 51.17 (13.68+1.00+13.12+18.37+5.00), tibia II: 9.70, tibia III: 7.50, tibia IV: 9.70; tibia I l/d 35.00.

Female (Paratype). (CNAN T0078). Similar to the male, differences: *Prosoma:* Carapace with marginal grey pattern on each side wider and darker than on male. Ocular region brown. Chelicerae distally brown in retrolateral and prolateral parts, basally grey in frontal part. *Legs:* Femora pale brown, the sub-distal ring darker than on male. Patellae darker than on male. Tibiae, metatarsi and tarsi pale brown. The two grey rings, one basal and another sub-distal on tibiae, darker than on male. *Epigynum:* Wider than long (Figs 196, 199). PP wide, curved laterally. MSE with Y-shaped upside down, two large concavities sac-shaped between MSE and PP (Figs 197, 200). *Measurements:* Total length 6.90. Carapace 2.70 long, 2.50 wide. Clypeus 0.95 long. Diameter AME 0.14, ALE 0.25, PME 0.22, PLE 0.24. Distance ALE-PME 0.18, PME-PME 0.27. Leg I: 45.70 (12.25+1.15+12.12+15.43+4.75), tibia II: 8.87, tibia III: 7.12, tibia IV: missing; tibia I l/d 27.85.

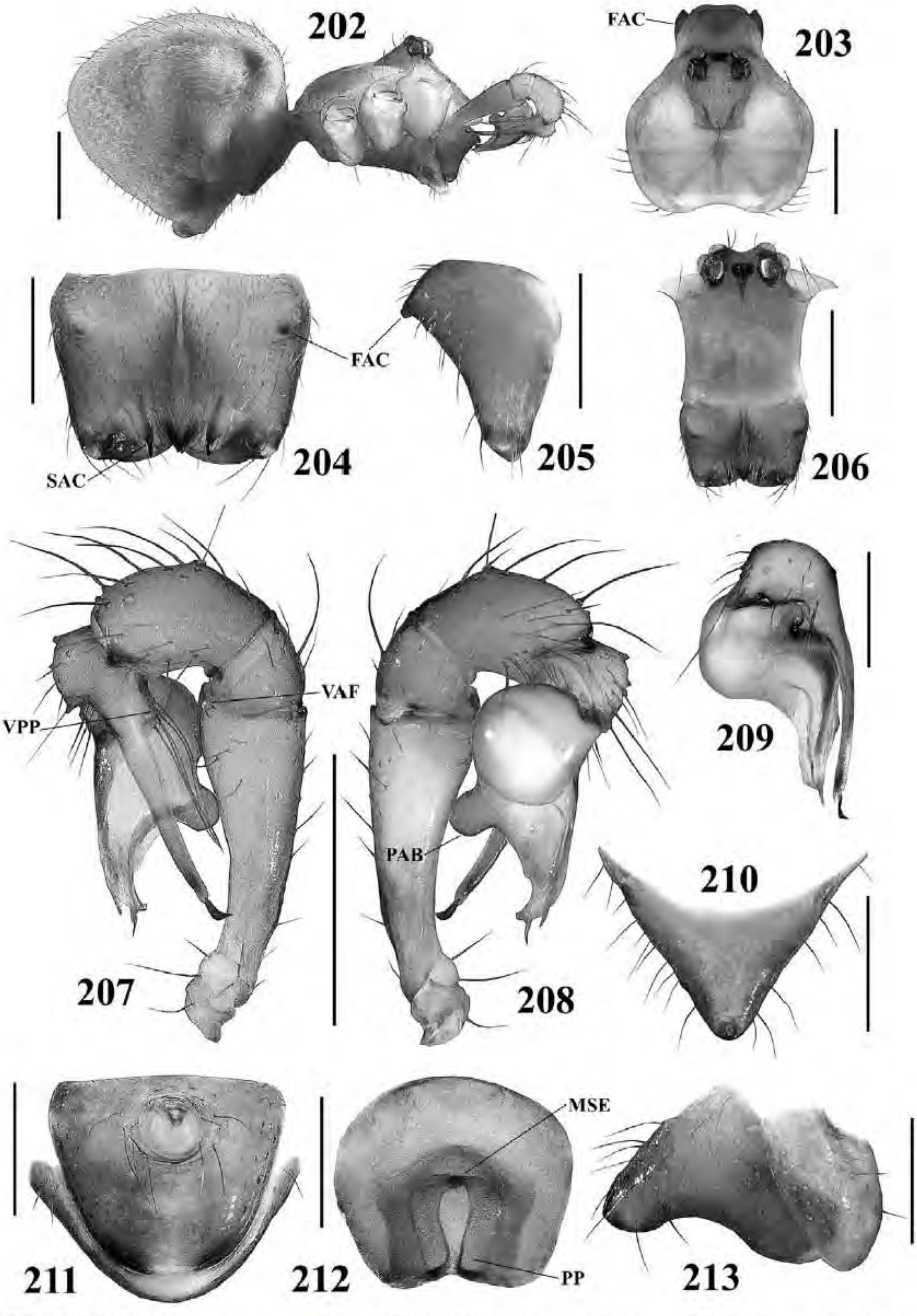
Variation. There is variation in general coloration and leg coloration between males and females, and within each sex. There is considerable variation in size in each sex. There is variation in the external shape of the epigynum, in female paratype (CNAN T0078) the ventral apophysis of epigynum (Figs 194, 196, 198) is slightly shorter than on the other females (Figs 195, 199, 201). Internally, there is variation in the shape of PP and MSE, female paratype (CNAN T0078) has PP slightly wider than females (CNAN T0080), and the MSE in the first female has Y-shaped upside down (Fig. 197), whereas in other females has U-shaped upside down (Fig. 200), besides which, the two sac-shaped concavities between MSE and PP are thinner and larger (Fig. 200). Male tibia I: 11.25–13.12 ($\bar{x}$= 12.41). Female tibia I: 9.37–15.25 ($\bar{x}$= 11.84).

Natural History. The type locality is in a karstic zone, and the specimens were collected in pine-oak forest in their irregular sheet webs among boulders on the ground (Fig. 11). The specimens were collected from 1.5 km along the road from Microwave Station La Pingüica, Querétaro (Fig. 10). They were collected in pine-oak forest, in their irregular sheet webs in a small cave (around 4 m of long) on the embankment next to the dirt road, with a humidity ca 60%. The other specimens collected from 200 m East of the junction to Pinal de Amoles-Bucarelli, Querétaro; were collected in pine-oak forest in a small and cold cave (around 5 m of long) on the embankment next to the road, with humidity ca 70%.

Distribution. *MEXICO: Hidalgo, Querétaro, San Luis Potosí* (Fig. 214).



FIGURES 186–201. *Ixchela huasteca* **new species**. Male: 186, Habitus, lateral view. 187, Carapace, dorsal view. 188, Carapace, frontal view. 189, Chelicerae, frontal view. 190, Chelicera, lateral view. 191, Bulb and procursus, dorsal view. 192–193, Left palp, retrolateral and prolateral views respectively. Females: Buanavista, near to Ahuacatlan: 194, Epigynum, frontal view. 196–197, Epigynum, ventral and dorsal view respectively. 198, Epigynum, left lateral view. 200 m E of junction road Pinal de Amoles-Bucarelli: 195, Epigynum, frontal view. 199–200, Epigynum, ventral and dorsal view respectively. 201, Epigynum, left lateral view. Scales: 1 mm (Figs 186–188, 192, 193), 0.5 mm (Figs 189–191, 194–201).



FIGURES 202–213. *Ixchela viquezi* **new species**. Male: 202, Habitus, lateral view. 203, Carapace, dorsal view. 204, Chelicerae, frontal view. 205, Chelicera, lateral view. 206, Carapace, frontal view. 207–208, Left palp, retrolateral and prolateral views respectively. 209, Bulb and procursus, dorsal view. Female: 210, Epigynum, frontal view. 211, Epigynum, ventral view. 212, Epigynum, dorsal view. 213, Epigynum, left lateral view. Scales: 1 mm (Figs 202, 206–208), 0.5 mm (Figs 203–205, 209–213).

Ixchela viquezi new species
Figures 202–213

Type data. *HONDURAS: Francisco Morazán:* 1 ♂ holotype (INBio) [24 September 2008; C. Víquez] from Oyuca (lat 14.0160°, lon -87.0833°, 1504m). 1 ♀ paratype (INBio) [28 September 2008; C. Víquez] from Parque Nacional La Tigra, about 10 km NE Tegucigalpa (lat 14.2121°, lon -87.0950°, 1800–1900 m).

Etymology. This species is dedicated to Dr. Carlos Víquez from Costa Rica, who loaned spiders of the family Pholcidae from Central America and for his participation in collecting the type series.

Diagnosis. Resembles to *I. franckei*, distinguished by the FAC smaller, with small tip distally (Figs 204, 205); by the SAC smaller (Fig. 204); by the PAB rounded and bigger (Figs 207, 208); and by the epigynum with wide apophysis, rounded distally (Figs 211, 213).

Description. Male (Holotype). *Prosoma:* Carapace pale orange, paler in anterior part behind the ocular region, and pale grey in distal half (Fig. 203). Carapace with three inconspicuous lines on each side (Fig. 203). Fovea without pattern surrounding it; ocular region brown, with a sparse reddish pattern posteriorly, next to the fovea, U-shaped (Fig. 203). Clypeus pale orange, with a wide light orange region, longitudinal (Fig. 206). Chelicerae light brown (Figs 204, 205). Sternum light olive, labium and endites pale brown, pale distally. Retrolateral apophysis of endites pale. *Legs:* Coxae and trochanters pale orange. Femora brown, paler basally, without rings, even without sub-distal ring that other species have. Tibiae, metatarsi and tarsi pale brown. *Opisthosoma:* Globular, dark blue, as long as high (Fig. 202). Plate of genital gonopore olive, trapezoidal. *Palp:* Femur conical, slightly curved, pale orange, becoming paler ventrally (Figs 207, 208). VAF small, conical, located in retrolateral-ventral position (Fig. 207). Patella and tibia orange. Procursus orange, darker distally, with distal spine, large and curved (Fig. 207). VPP conical, with few and large setae (Fig. 207). Embolus wide, distally curved; apically with dorsal small spine and ventrally with small projection spine-shaped (Figs 207–209). *Measurements.* Total length 5.30. Carapace 2.25 long, 2.10 wide. Clypeus length 1.00. Diameter AME 0.06, ALE 0.17, PME 0.14, PLE 0.20. Distance ALE-PME 0.09, PME-PME 0.26. Leg I: missing, tibia II: missing, tibia III: missing, tibia IV: 7.30; tibia I l/d missing.

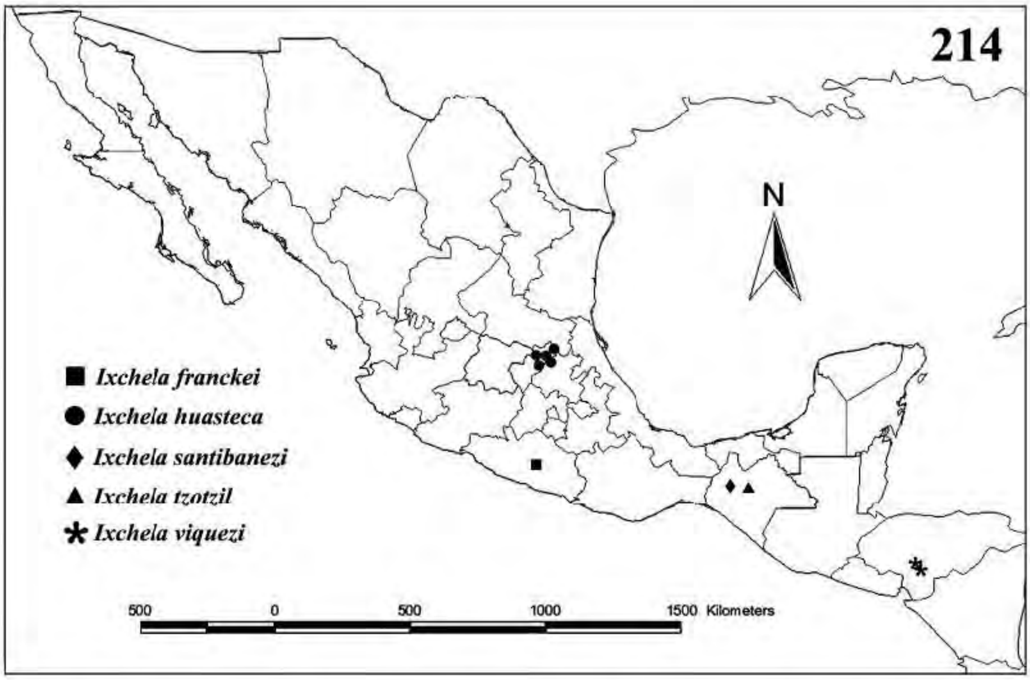


FIGURE 214. Known distribution of *Ixchela franckei* new species, *Ixchela huasteca* new species, *Ixchela santibanezi* new species, *Ixchela tzotzil* new species and *Ixchela viquezi* new species.

Female (Paratype). Similar to the male, differences: *Prosoma:* Distal half of carapace grey, darker than the male. Ocular region paler brown than on male. Clypeus with a brown region, wide and longitudinal. Sternum olive, darker than on male. *Legs:* Coxae and trochanters pale orange, becoming olive in prolateral and retrolateral part. Femora, tibiae, metatarsi and tarsi paler brown than the male. *Epigynum:* Wider than long (Figs 210, 211, 213). In frontal and ventral views with small rounded pit (Figs 210, 211). PP larger than wide, forming a space U-shaped upside down between them; MSE thin and inconspicuous (Fig. 212). *Measurements:* Total length 5.00. Carapace 2.00 long, 1.95 wide. Clypeus 0.90 long. Diameter AME 0.08, ALE 0.16, PME 0.12, PLE 0.14. Distance ALE-PME 0.08, PME-PME 0.22. Leg I: 33.27 (9.00+0.87+8.90+11.00+3.50), tibia II: 6.40, tibia III: missing, tibia IV: missing; tibia I l/d 35.60.

Distribution. *HONDURAS* (Fig. 214).

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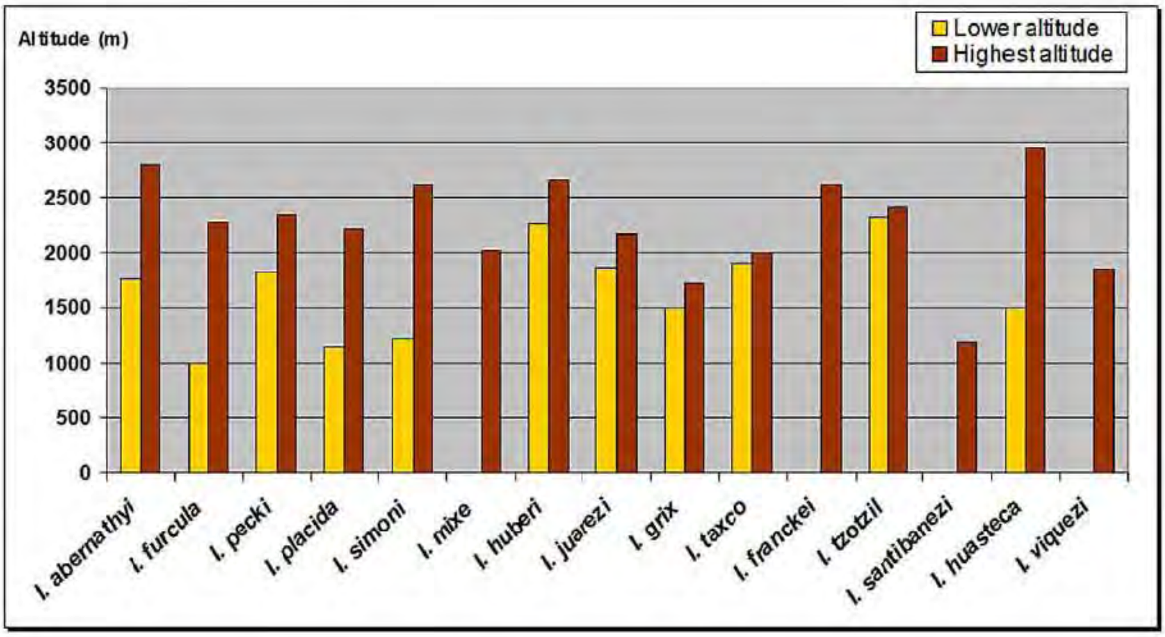
APPENDIX 1. Elevation range that the species of the genus *Ixchela* Huber, 2000 were found between 1000–2950 m of elevation



3. CAPITULO II

ARTICULO COMPLEMENTARIO

"Phylogeny of the spider genus *Ixchela* Huber, 2000 (Araneae: Pholcidae) based on morphological and molecular evidence (CO1 and 16S)"

Phylogeny of the spider genus *Ixchela* Huber, 2000 (Araneae: Pholcidae) based on morphological and molecular evidence (CO1 and 16S)

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The genus *Ixchela* Huber, 2000 is composed of 20 species distributed from Northeastern Mexico to Central America, counting the five new species described here from Mexico: *Ixchela azteca*, *Ixchela jalisco*, *Ixchela mendozai*, *Ixchela purepecha*, and *Ixchela tlayuda*. In this study, we test the monophyly and investigate the phylogenetic relationship in the genus *Ixchela* using both morphological and molecular data from (cytochrome oxidase 1 (CO1) and 16S rRNA genes) data. Parsimony analysis (PA) of 40 morphological characters with equal and implied weighting recovered five most parsimonious trees under both conditions. Monophyly of *Ixchela* is supported by eight morphological synaphomorphies: 1) a bulb prolateroventral apophysis on the male palp; 2) a long and slender femur of the male palp, with cone-shaped; 3) an apical ventral projection on the embolus; 4) an apical dorsal projection with spine-shape on the embolus; 5) a sclerotized spine small and curved, distally on the procursus; 6) a long setae present on ventral protuberance of the procursus; 7) a procursus conical and long, wide basally; and 8) a small and sub-distal sclerotized ventral spine on the embolus. The PA analyses under equal and implied weighting, and Bayesian inference (BI) analyses for the separate CO1 gene (506 characters), 16S gene (379 characters), concatenated gene fragments CO1+16S (885 characters), and the combined evidence data set (morphology+CO1+16S) (925 characters) consistently support the monopyly of the *Ixchela*. Our preferred topology found two large clades, the clade 1 have a natural distribution toward the Mesoamerican biotic component, whereas the clade 2 toward the Mexican Mountain biotic component.

ADDITIONAL KEYWORDS: New species – taxonomy – monophyly – morphology – parsimony – Bayesian inference.

INTRODUCTION

The spider family Pholcidae C. L. Koch, 1850 is currently composed of five subfamilies: Ninetinae Simon, 1890; Arteminae Simon, 1893; Modisiminae Simon, 1893; Smeringopinae Simon, 1893; and Pholcinae C. L. Koch, 1850 (Huber, 2011). The subfamily Modisiminae currently includes 412 species grouped in 33 genera, some of which are considerably specious (e.g., *Anopsicus* Chamberlin & Ivie, 1938; *Psilochorus* Simon, 1893; *Modisimus* Simon, 1893, *Mesabolivar* González-Sponga, 1998); and many undescribed species (Huber, 2011). Although some clades have been identified within the subfamily, the phylogenetic relationships within Modisiminae are not clearly resolved yet. There are some clades within Modisiminae that are morphologically supported (Huber, 1998b; 2011), though molecular data do not support the monophyly of this taxon (Huber & Astrin, 2009).

Within the subfamily Modisiminae, the spider genus *Ixchela* Huber, 2000 was previously composed only of five species (O. Pickard-Cambridge 1898; F. O. Pickard-Cambridge, 1902; Gertsch, 1971) until Valdez-Mondragón (2013) described nine and one new species from Mexico and one from Honduras, respectively; with a total of 15 described species previously.

The monophyly of the genus *Ixchela* has never been tested. This genus was proposed to be supported only by one character, the distinctive prolateroventral apophysis of the palp bulb of the male (Huber 1998, 2000; Valdez-Mondragón, 2013). In addition, the phylogenetic relationships among *Ixchela* and other genera of the subfamily Modisiminae are not clear. Huber (2000) mentions that members of *Ixchela* share several synapomorphies with other genera of the subfamily, such as the exposed tarsal organ, male palpal coxa with retrolateral apophysis, male gonopore without epiandrous spigots, anterior lateral spinnerets with only one piriform gland spigot each, and large PME-ALE distance. Huber (2000), however, mentioned that *Ixchela* resembles *Aymaria* Huber, 2000 in overall shape, it is only superficial similarity and not due to synapomorphies that link the two genera or that link *Ixchela* with any other sister genus within Modisiminae (Huber, 2011).

Here, we present the first phylogenetic analysis of the genus *Ixchela* Huber, 2000, testing its monophyly with different kinds of data, using morphology and two mitochondrial genes (CO1 and 16S). We generated nucleotide sequences from two mitochondrial genes, selected because their substitution rates allow the establishment of the relationships at species level, as shown by previous phylogenetic analyses in spiders and other arthropod groups, including the family Pholcidae (e.g. Hebert *et al.*, 2003b; Arnedo *et al*, 2004; Bruvo-Madaric *et al*., 2005; Astrin *et al*., 2006; Álvarez-Padilla *et al*., 2009; Hendrixson *et al*., 2013). Besides, this study describes five additional new species as a result of a recent taxonomic revision of the genus *Ixchela* (Valdez-Mondragón, 2013); presents new morphological and biogeographical data.

MATERIAL AND METHODS

Biological material. The biological material used in this study was collected as additional work carried out by Valdez-Mondragón (2013). We examined specimens deposited in the following museums and institutions: Colección Nacional de Arácnidos, Instituto de Biología, Universidad Nacional Autónoma de México, Mexico City (CNAN); Universidad Michoacana de San Nicolás de Hidalgo, Michoacán, Mexico (UMSNH); American Museum of Natural History, New York, U. S. A. (AMNH); Texas Memorial Museum, University of Texas, Austin, Texas, U. S. A. (TMM-UT); Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica (INBio). The specimens were examined under a Nikon SMZ645 stereoscopic microscope. All measurements are in millimeters (mm). Female epigyna and male palps were dissected in ethanol (80%) and cleared in potassium hydroxide (KOH-10%) for five minutes. Photographs were taken with a Nikon Coolpix S10 VR camera with an adapter for the microscope. Morphological structures were placed in 96% gel alcohol to facilitate positioning and covered with a thin layer of liquid ethanol (80%) to minimize diffraction during photography. The photomicrographs were taken with a HITACHI

SU1510 scanning electron microscope (SEM). All scale measurements on SEM photomicrographs are in microns (µm). The maps were done with ArcView GIS version 3.2 (Applegate, 1999). The localities were georeferenced using the format (latitude and longitude) in decimal degrees because in this format the maps can be made in ArcView GIS versión 3.2. The photographs and maps were edited using Adobe Photoshop Version 7.0. Abbreviations: ALE, anterior lateral eyes; AME, anterior median eyes; FAC, frontal apophysis of chelicerae; MSE, median septum of epigynum; PAB, prolateroventral apophysis of bulb; PLE, posterior lateral eyes; PME, posterior median eyes; PP, pore plates; SAC, sclerotized apophysis of chelicerae; VAE, ventral apophysis of epigynum; VAF, ventrodistal apophysis of femur; VPP, ventrobasal protuberance of procursus.

Taxon sampling. The cladistic analyses presented here, are based on 28 taxa. The species used in the molecular analyses are listed in Table 1. The ingroup includes 20 species of *Ixchela* [15 species described previously by Valdez-Mondragón (2013) and five new species described here]. Outgroups for the morphological analysis include *Physocyclus dugesi* Simon, 1893; *Priscula binghamae* (Chamberlin, 1916); ‘*Coryssocnemis’ ivie* Gertsch, 1971; *Aymaria conica* (Banks, 1902); and *Mesabolivar cyaneomaculatus* (Keyserling, 1891). Outgroups for molecular analyses include *Physocyclus dugesi* Simon, 1893; *Carapoia paraguaensis* González-Sponga, 1998; *Mesabolivar luteus* (Keyserling, 1891); *Priscula binghamae* (Chamberlin, 1916); and *Coryssocnemis simla* Huber, 2000. The outgroup taxa were selected based on previous analyses of phylogenetic relationships of the family Pholcidae (Huber 2000, 2011). Outgroup sequences were retrieved from GenBank, because it was not possible to obtain fresh tissues.

Table 1. Specimens sequenced for each species, DNA voucher numbers, localities, and GenBank accession numbers.

Species	*DNA Voucher CNAN	Locality	GenBank Accession Number CO1	16S
Ixchela abernathyi (Gertsch)	Ara0238	MEXICO: San Luis Potosí	KF150114	KF178420
Ixchela franckei Valdez-Mondragón	Ara0164	MEXICO: Guerrero	KF150084	KF178390
Ixchela furcula (F. O. Pickard-Cambridge)	Ara0316	GUATEMALA: Sacatepequez	KF150127	KF178433
Ixchela grix Valdez-Mondragón	Ara0235	MEXICO: Oaxaca	KF150111	KF178417
Ixchela huasteca Valdez-Mondragón	Ara0194	MEXICO: Querétaro	KF150101	KF178407
Ixchela huberi Valdez-Mondragón	Ara0190	MEXICO: Oaxaca	KF150098	KF178404
Ixchela juarezi Valdez-Mondragón	Ara0218	MEXICO: Oaxaca	KF150108	KF178414
Ixchela mixe Valdez-Mondragón	Ara0173	MEXICO: Oaxaca	KF150090	KF178396
Ixchela pecki (Gertsch)	Ara0308	MEXICO: Chiapas	KF150125	KF178431
Ixchela placida (Gertsch)	Ara0201	MEXICO: Veracruz	KF150105	KF178411
Ixchela santibanezi Valdez-Mondragón	Ara0309	MEXICO: Chiapas	KF150126	KF178432
Ixchela simoni (O. Pickard-Cambridge)	Ara0320	MEXICO: Guerrero	KF150129	KF178435
Ixchela taxco Valdez-Mondragón	Ara0273	MEXICO: Guerrero	KF150089	KF178395
Ixchela tzotzil Valdez-Mondragón	Ara0303	MEXICO: Chiapas	KF150123	KF178429
Ixchela viquezi Valdez-Mondragón	Ara0319	HONDURAS: Fco. Morazán	KF150128	KF178434
Ixchela azteca new species	Ara0158	MEXICO: Distrito Federal	KF150079	KF178385
Ixchela jalisco new species	Ara0328	MEXICO: Jalisco	KF150131	KF178437
Ixchela mendozai new species	Ara0326	MEXICO: Puebla	KF150130	KF178436
Ixchela purepecha new species	Ara0253	MEXICO: Michoacán	KF150119	KF178425
Ixchela tlayuda new species	Ara0225	MEXICO: Oaxaca	KF150097	KF178403

Outgroups				
Coryssocnemis simla Huber	GenBank	VENEZUELA: Sucre	AY560773	DQ667753
Carapoia paraguaensis González-Sponga	GenBank	VENEZUELA: El Dorado	DQ667855	DQ667749
Mesabolivar luteus Huber	GenBank	BRAZIL: Minas Gerais	DQ667873	DQ667766
Physocyclus dugesi Simon	GenBank	COSTA RICA: San Pedro de Montes de Oca	AY560787	—
Physocyclus globosus (Taczanowski)	GenBank	GUATEMALA: Lívingston	—	DQ667821
Priscula binghamae (Chamberlin)	GenBank	BOLIVIA: La Paz	DQ667932	DQ667826
Psilochorus simoni (Berland)	GenBank	GERMANY: Bonn	AY560789	—
Tainonia serripes (Simon)	GenBank	DOMINICAN REPUBLIC: NE Paraiso	FJ799790	FJ799777

*Voucher of all species of the ingroup are deposited at Colección Nacional de Arácnidos (CNAN), Institute of Biology, UNAM, México.

Morphological data. The morphological matrix comprises 40 characters, 34 binary and six multistate (Appendix). Thirty-two characters were potentially informative and eight were uninformative. In the analyses with equal and implied weighting, uninformative characters were deactivated to avoid inflating the tree length (L) and consistency index (CI). The matrix was created in WinClada-Asado, version 1.7 (Nixon, 2004). Multistate characters were considered as non-additive (Fitch, 1971).

DNA extraction, amplification, and sequencing. The specimens and tissues were preserved in 96% or 100% ethanol at -18°C. The DNA extractions varied depending on the available material and on the specimens' body size. DNA was isolated in different cases from prosoma (immatures), opisthosoma (immatures) or half opisthosoma (adults), complete legs (immatures), leg femur or half leg femur (adults), femur+patella+tibia (immatures), or in some cases from the whole individual spider (small immatures). The DNA extractions were done using the Qiagen DNeasy Tissue Kit. Extractions were verified by electrophoresis in 1% agarose gel (100 ml TBE+1g agarose SIGMA-ALDRICH), using a ladder marker of 100 bp. DNA fragments corresponding to approximately 620 bp of Cytochrome c oxidase subunit 1 (CO1) gene and approximately 440 bp of 16S ribosomal RNA gene were obtained. The fragments were amplified using the primers shown in Table 2.

Table 2. Primers used for PCR.

Gene	Primer name	Primer sequence (5'-3')	References
CO1	LCO1490	GGTCAACAAATCATAAAGATATTGG	Folmer *et al.* (1994)
	HC02198	TAAACTTCAGGGTGACCAAAAAATCA	
16 S rRNA	6sar-5'	CGCCTGTTTATCAAAAACAT	Hillis, Moritz & Mable (1996)
	6sbr-3'	CCGGTCTGAACTCAGATCACGT	

Amplifications were carried out in an AB-Applied Biosystems Thermal Cycler mod. 2720, in a total volume of 25 µl containing 2.5 µl DNA, 2.5 PCR 10X buffer, 1.5 µl $MgCl_2$, 1.0 µl dNTPs, 0.5 µL of molecular marker for CO1 and 1 µL for 16S , 16 µL H_2O for CO1 and 15 µL for 16S, and 0.5 µl *Taq* PCR Core polymerase (Qiagen). The PCR program for CO1 was as follows: one cycle of 30 repeats; denaturation at 94°C for 20s; annealing at 48°C for 20s; extension at 72°C for 40s (Huber *et al.*, 2010). The PCR program for 16S was as follows: two cycles, the first cycle consisted of 7-9 repeats; denaturation at 94°C for 30s, annealing at 55°C (-1°C per cycle) for 30s, extension at 72°C for 50s; the second cycle consisted of 23 repeats, denaturation at 94°C for 30s, annealing at 50°C for 30s, extension at 72°C for 50s (Astrin *et al*., 2006). PCR products were checked to analyze length and purity on 1% agarose gels and purified directly from the PCR mixture using a Millipore Amicon-Ultra 0.5 µl Centrifugal Filters Kit; purification were checked on 1% agarose gels with a marker of 100 bp. DNA extraction, amplification, and sequencing were performed at the Molecular Laboratory at the Instituto de Biología, Universidad Nacional Autónoma de México (UNAM). Sequencing of both strands (5'-3' and 3'-5') of PCR products were done in a Genetic Analyzer RUO AB-Applied Biosystems HITACHI mod. 3500xL. Sequence data are deposited in GenBank (www.ncbi.nih.gov) under Accession Numbers: KF150079-KF150131 for CO1 and KF178385-KF178437 for 16S (Table 1).

DNA sequence alignment and edition. Sequences were aligned using the default Gap opening penalty 1.53 in MAFFT (Multiple sequences Alignment based on Fast Fourier Transform) Version 6 (Katoh & Toh, 2008) available on line; using the following alignment strategy: Auto (FFT-NS-2, FFT-NS-i or L-INS-i; depending on data size). The inspection and editing of sequences and alignments were done using BioEdit Version 7.0.5.3 (Hall, 1999). The BioEdit matrixes were exported to WinClada-Asado, version 1.7 (Nixon, 2004), to run the analyses under NONA version 1.8 (Goloboff, 1993a). The matrixes obtained from the multiple sequences alignments were then used in both Parsimony (PA) and Bayesian inference (BI) analyses. For the Bayesian analyses, MrBayes version 3.1 (Huelsenbeck & Ronquist, 2001) was run under the WinClada-Asado interface.

Phylogenetic analyses. Phylogenetic analyses were performed using Parsimony (PA) under NONA version 1.8 (Goloboff, 1993a); and Bayesian Inference (BI) with Markov Chain Monte Carlo (MCMC) using MrBayes version 3.1 (Huelsenbeck & Ronquist, 2001). Partition-homogeneity tests (ILD-test) were done under NONA version 1.8 (Goloboff, 1993a) to analyze congruence between partitions (CO1, 16S, and morphology). The analyses with PA were done with equal character weighting and implied character weighting; uninformative characters were deactivated to avoid inflating the tree length and consistency index (CI) (Goloboff, 1993b; 1995). PA and BI analyses were applied for each separate matrix as well as for the combined evidence. PA analyses with equal weighting were run using heuristic search with NONA. The analyses with NONA were conducted using WinClada-Asado, version 1.7 (Nixon, 2004). Ambiguous optimizations were resolved using accelerated transformation (ACCTRAN), which favors reversals over parallelisms to explain homoplasy on the topologies (Farris, 1970; Swofford & Maddison, 1987; Agnarsson & Miller, 2008). The trees were edited with WinClada-Asado and Adobe Photoshop 7.0. In NONA, the analyses with equal weighting were conducted using the following commands: Maximum trees to keep (hold)= 10000; No. of replications (mult*N)= 1000; Starting trees per rep (hold/)= 50; using Multiple TBR+TBR (mult*max*).

Trees were rooted with *Physocyclus dugesi*, since this species belongs to the subfamily Arteminae, which is closely related to the Modisiminae where *Ixchela* is placed. The implied character weighting of both morphological and molecular analyses, were conducted to analyze the effects of weighting against homoplasy. PA analyses with implied weighting were done using traditional search with TNT (Goloboff *et al*. 2008) with the following commands: Starting trees using Wagner trees: Random seed= 1000; Replications (Number of add. seqs.)= 1000; Swapping algorithm (TBR): trees to save per replication= 100. The seven arbitrary values for the concavity constant used were: *K*= 1, 2, 3, 4, 5, 9, 10.

To run the Jackknife (Farris *et al.*, 1996) and Bremer (Bremer, 1988) support values for PA with equal and implied weightings under TNT (Goloboff *et al*., 2008), in

Winclada-Asado the morphological matrix was exported to NONA format (.ss); whereas the molecular and combined matrixes were exported first to Nexus file (.nex), and then with the program Mesquite, version 2.75 (Maddison & Maddison, 2011) were exported to TNT file (.tnt). The Jackknife values were calculated with the following commands: Number of replicates= 1000; Search trees with traditional search; only the significant values >64% are shown on the trees. The Bremer values were calculated with the following commands: Retains trees suboptimal: 20 steps (morphological data), 40 steps (molecular data); Nodes were collapsed with support below 1; Type of support: absolute support; Calculate supports with existing suboptimal trees.

The models of sequence evolution were selected by JModelTest version 0.1.1 (Guindon & Gascuel, 2003; Posada, 2008) under the Akaike Information Criterion (AIC) (Posada & Buckley, 2004). BI analyses with four parallel Markov chains were run with the following commands: MCMC generations= 5000000; sampling frequency= 200; print frequency= 200; number of runs= 2; number of chains= 4; NST= 6; NCAT= 4; Rates= GTR+I+G (CO1, CO1+16S, total evidence), GTR+G (16S); MCMC burnin= 2500; sumt burnin= 2500; sump burnin= 2500. TRACER v 1.5 was used to analyze the parameters and the effective sample size (ESS) of the MCMC (Rambaut & Drummond, 2003-2009).

RESULTS

TAXONOMY

PHOLCIDAE C. L. Koch, 1850

IXCHELA Huber, 2000

Type species: Ixchela furcula (F. O. Pickard-Cambridge, 1902), originally described in *Coryssocnemis* Simon, 1893; by original designation (Huber, 2000). Type locality: 1 female holotype from Tecpam in the Región de Los Altos (Tecpam, Departamento Chimaltenango), Guatemala, around 2300 m, Godman & Salvin Cols., in BMNH (F. O. Pickard-Cambridge, 1902; Huber, 1998).

Diagnosis: Species of this genus can be distinguished from members of other pholcid genera by the prolateroventral apophysis of the palp bulb of the male (PAB) (Figs 1, 39, 50); the apical-dorsal spine-shaped projection on the embolus (Figs 2, 38, 49); the apical-ventral projection on the embolus (Figs 2, 38, 49); the curved spine distally on procursus (Figs 38, 49, 60); the ventral protuberance with long setae on the procursus (VPP) (Figs 15, 38, 49); the conical, straight and long procursus, wide basally (Figs 60, 72); the sclerotized small, sub-distal spine on the embolus (Figs 9, 39, 50); and the frontal apophysis on chelicerae on males (FAC) (Figs 26, 40, 51).

Description (update): The description made by Valdez-Mondragón (2013) currently still valid, although new additional morphological information has been found with scanning electron microscope (SEM) and is explained next. Embolus conical (Fig. 1), with elongate, sigmoid apical ventral projection (Figs 2, 4, 6), and apical dorsal projection spine-shaped (Fig. 2). Sperm operculum with a small spine (arrow, Fig. 3). Embolus with small, spine-shaped projections on prolateral part (e.g. *I. azteca*, arrow Fig. 4, Fig. 5; and *I. mendozai*, arrow Fig. 8, Figs 7, 9). Embolus with sclerotized spine sub-distally (arrow, Fig. 9). Female palp with long and wide setae next to the tarsal organ (Figs 12, 13, 17). Bulb rounded and wide (Fig. 1). Tarsal organs exposed in palps (arrows Figs 16, 17), and legs (arrow Fig. 24, Fig. 25). Trichobothria present on palp tibia of males and females (Figs. 10-12). Lyriform organs present on leg patellae (arrow Fig. 18, Fig. 19). Legs with 6-9 longitudinal rows of erect setae, spread around circumference of segments (Figs. 20, 21), without spines or curved setae. Tarsus IV with comb-hairs (arrows Fig. 22, Fig. 23). Male chelicerae with SAC well developed on some species (e.g. *I. azteca*, *I. mendozai*) (Figs 26, 27), vestigial on others (e.g. *I. simoni*, *I. tzotzil*) (Valdez-Mondragón, 2013; figs 74, 162); or absent (e.g. *I. furcula*, *I. huberi*) (Valdez-Mondragón, 2013; figs 34, 100). Endites with serrated margin (arrow Fig. 29, Fig. 30). Anterior lateral spinnerets with one, slightly pointed spigot, and one wide spigot (arrows, Fig. 32). Posterior median spinnerets with two acciniform gland spigots (arrows, Fig. 33).

Distribution and Natural History: The distribution and natural history given by Valdez-Mondragón (2013) is still the same, although new data on the natural history were obtained and are explained below. The genus *Ixchela* Huber, 2000 is widely distributed from Northeastern Mexico to Nicaragua. The genus has a natural distribution in temperate climate zones, particularly pine, oak or mixed pine-oak forest (1000-2950 m of elevation) (Valdez-Mondragón, 2013; figs 13-15, 17, 18); although some species were collected in tropical rain forest as *Ixchela santibanezi* Valdez-Mondragón, 2013 at 1190 m (Valdez-Mondragón, 2013; fig. 16), or in a thorny scrub forest as *Ixchela juarezi* Valdez-Mondragón, 2013 at 1900-2180 m. Most of the species have been collected among fallen logs, boulders on the ground, under dry leaves of agave plants and frequently on walls along road-cuts, specifically in dark, moist areas covered with roots and leaf-litter (Valdez-Mondragón, 2013; figs. 15, 17, 18), or inside caves (Valdez-Mondragón, 2013; figs. 1-3, 5, 9). However, in this work three synanthropic records for the genus are reported for the first time: two records of *Ixchela azteca* and one record of *Ixchela mendozai* found inside buildings.

Composition. The genus *Ixchela* is composed of 20 species: *Ixchela simoni* (O. Pickard-Cambridge, 1898), *Ixchela furcula* (F. O. Pickard-Cambridge, 1902), *Ixchela abernathyi* (Gertsch, 1971), *Ixchela pecki* (Gertsch, 1971), *Ixchela placida* (Gertsch, 1971), *Ixchela franckei* Valdez-Mondragón, 2013, *Ixchela grix* Valdez-Mondragón, 2013, *Ixchela huasteca* Valdez-Mondragón, 2013, *Ixchela huberi* Valdez-Mondragón, 2013, *Ixchela juarezi* Valdez-Mondragón, 2013, *Ixchela mixe* Valdez-Mondragón, 2013, *Ixchela santibanezi* Valdez-Mondragón, 2013, *Ixchela taxco* Valdez-Mondragón, 2013, *Ixchela tzotzil* Valdez-Mondragón, 2013, *Ixchela viquezi* Valdez-Mondragón, 2013, *Ixchela azteca* new species, *Ixchela jalisco* new species, *Ixchela mendozai* new species, *Ixchela purepecha* new species, and *Ixchela tlayuda* new species. The types of *I. abernathyi*, *I. furcula*, *I. pecki*, *I. placida*, and *I. simoni* were not examined; only topotypes of *I. abernathyi* and *I. simoni*, although many specimens of the other species from CNAN, AMNH, TMM-UT and INBio were available for this study, besides additional material that was reported previously by Valdez-Mondragón (2013).

Key to identification of species of *Ixchela* Huber, 2000; updated from Valdez-Mondragón (2013), using same abbreviations.

Males

1. Chelicerae with well developed SAC (Figs 37, 48, 59)………………….……………..…...……**2**
– Chelicerae without or with inconspicuous SAC (VM, 2013; figs 34, 74, 100)……….….…..…**11**
2 (1). Chelicerae with conical and long FAC (Figs 40, 51, 74)…..……………………………...**4**
– Chelicerae with conical and small FAC (VM, 2013; figs 150, 205)……….............…………..**3**
3 (2). Chelicerae with FAC wide basally with tip slightly curved (VM, 2013; figs 149, 150); embolus with basal protuberance conical, ending in round tip near PAB (VM, 2013; figs 153,

154); palp with small PAB (VM, 2013; figs 153, 154); wide and short palp femur, 2X longer than wide (VM, 2013; figs 152, 153); long distal spine of procursus, curved basally and straight distally (VM, 2013; figs 152, 153)………..….…………..***Ixchela franckei* Valdez-Mondragón**

– Chelicerae with small and narrowing evenly FAC (VM, 2013; figs 204, 205); embolus without basal protuberance (VM, 2013; fig. 208); palp with large PAB (VM, 2013; figs 207, 208); thin and long palp femur (VM, 2013; figs 207, 208); long distal spine of procursus, straight basally and curved distally J-shaped (VM, 2013; figs 207–209)………………………..
……………………………………….........................***Ixchela viquezi* Valdez-Mondragón**

4 (2). Palp femur without ventral protuberances (Fig. 38, 49), chelicerae with moderate or large FAC, located on basal one third (Figs 40, 51)………………………………………….……..**5**

– Palp femur with a ventral conical protuberance (VM, 2013; arrow fig. 140); chelicerae with curved FAC, located basally (VM, 2013; figs 136, 137)…….***Ixchela taxco* Valdez-Mondragón**

5 (4). FAC pointed apically (VM, 2013; figs 22, 63)……………..……..…………….….……**6**

– FAC wide apically (Fig. 62, 85).……………………………………………………….………**9**

6 (5). Palp femur markedly curved ventrally (Figs 38, 49)……….……………………………...…**7**

– Palp femur concave ventrally (VM, 2013; figs 25, 65)..……………….……………...…..**8**

7 (6). Wide and conical FAC, directed toward front (Figs 37, 40); small VAF (Figs 38, 39); color pattern around the fovea very marked and with the same width along (Fig. 35).….............
………...***Ixchela azteca* new species**

– Very long FAC, directed toward up and slightly curved apically (Figs 48, 51); long and curved VAF (Figs 49, 50); color pattern around the fovea less marked than *I. azteca*, wider in anterior part than posterior part (Fig. 46)………………………..…..***Ixchela jalisco* new species**

8 (7). Retrolateral face of palp femur with several setae medially (VM, 2013; fig. 25); straight and wide PAB, not forming a distinct notch between PAB and embolus (VM, 2013; fig. 26)...
…………………………………………………..……….…***Ixchela abernathyi* (Gertsch)**

– Retrolateral face of palp femur without setae medially (VM, 2013; fig. 65); narrow and curved PAB, forming a distinct notch between PAB and embolus (VM, 2013; fig. 66)…............
……………………………………………………………..….***Ixchela placida* (Gertsch)**

9 (6). FAC forming an angle of >90° with the chelicerae in lateral view……………..…....**10**

– FAC forming an angle of 90° with the chelicerae in lateral view, long and rounded FAC (Fig. 62)…...………………...……………………………………***Ixchela mendozai* new species**

10 (9). FAC wide distally and ending in a small tip (Fig. 85).......….***Ixchela tlayuda* new species**

– FAC wide and round distally (Fig. 74)………………...….***Ixchela purepecha* new species**

11 (1). FAC with frontal and curved sclerotized apophyses (VM, 2013; figs 50, 89, 176)….…**12**

– FAC without frontal and curved sclerotized apophyses…………………………………**14**

12 (11). Small and non-protruding PAB (VM, 2013; figs 54, 181); curved sclerotized apophyses claw-shaped, long and pointing forward (VM, 2013; figs. 49, 175)...……………………...….**13**

– Strongly developed PAB, distinctly protruding (VM, 2013; fig. 92); curved sclerotized apophyses on FAC hook-shaped, short, pointing towards each other (VM, 2013; figs 88–90)….
………...……………………………………………...….***Ixchela mixe* Valdez-Mondragón**

13 (12). Short FAC, located slightly distal to middle of chelicerae (VM, 2013; fig. 50), curved sclerotized apophyses on FAC oblique to mid-line of chelicerae and located in the middle of a large pale patch (VM, 2013; fig. 49)……………………………..…...***Ixchela pecki* (Gertsch)**

– Strongly developed FAC, located on basal third of chelicerae (VM, 2013; fig. 176); curved sclerotized apophyses on FAC parallel to mid-line of chelicerae and above a small pale patch (VM, 2013; fig. 175)………………...……......***Ixchela santibanezi* Valdez-Mondragón**

14 (11). Chelicerae with SAC inconspicuous, but readily distinguished (VM, 2013; figs 74, 162)
……………………………………………………………………………………………..**15**

– Chelicerae without SAC (VM, 2013; figs 34, 100, 124)…………………...…………...**18**

15 (14). Palp femur ≤2.5 X longer than wide (VM, 2013; figs 78, 192)..........………….……..**16**

– Palp femur >2.6 X longer than wide (VM, 2013; figs 115, 167)………......…………**17**

16 (15). In lateral view, short and blunt FAC (VM, 2013; fig. 75); ventral-distally, embolus with long and wide projection, leaf-shaped (VM, 2013; fig. 80); marginal pattern of coloration each side on carapace distinct, wide (VM, 2013; fig. 73)……………………………………………
………………………………………...........……***Ixchela simoni* (O. Pickard-Cambridge)**

– In lateral view, rounded and protruding FAC (VM, 2013; fig. 190); ventral-distally, embolus with long, thin, curved projection (VM, 2013; fig. 191); marginal pattern of coloration each side on carapace diffuse, narrow (VM, 2013; fig. 87)………...
…...….…*Ixchela huasteca* **Valdez-Mondragón**

17 (15). Rounded and blunt FAC; with narrow base (VM, 2013; fig. 113); frontal face of chelicerae angled, meeting medially at oblique angles (VM, 2013; fig. 112); palp femur distinctly angled on basal fourth (VM, 2013; figs 115, 116); embolus distally broad and blunt; long and thin PAB, finger-like (VM, 2013; fig. 116); in frontal view, chelicerae evenly colored, pale (VM, 2013; fig. 112)……………………….……..………..….*Ixchela juarezi* **Valdez-Mondragón**

– Conical FAC; with broad base (VM, 2013; fig. 162); frontal face of chelicerae flat, meeting medially on the same plane (VM, 2013; fig. 162); palp femur not angled on basal fourth (VM, 2013; figs 167, 168); embolus distally tapering and narrow (VM, 2013; figs 166–168); wide-based and short PAB, thumb-like (VM, 2013; fig. 168); in frontal view, chelicerae with FAC region distinctly darker, contrasting with pale basal and distal regions (VM, 2013; figs 162)….………………………………………….....*Ixchela tzotzil* **Valdez-Mondragón**

18 (14). Chelicerae with a pale region distally to chelicerae (VM, 2013; figs 33, 34); fovea with color pattern around it touching the posterior part of ocular region (VM, 2013; fig. 32); long and conical FAC, claw-shaped distally (VM, 2013; figs 34, 35); PAB with a distinct medial constriction (VM, 2013; fig. 38)............................*Ixchela furcula* **(F. O. Pickard-Cambridge)**

– Chelicerae without a pale region distally to chelicerae (VM, 2013; figs 100, 124); fovea with color pattern around it not touching the posterior part of ocular region (VM, 2013; figs 99, 123)...**19**

19 (18). In lateral view, apically wide and flat FAC (VM, 2013; fig. 101); FAC directed frontally (VM, 2013; figs. 100, 102); wide palp femur, <2.5 X longer than wide (VM, 2013; figs. 103, 104)...*Ixchela huberi* **Valdez-Mondragón**

– In lateral view, apically small and rounded FAC (VM, 2013; Fig. 124); FAC directed towards each other (VM, 2013; figs. 124, 126); thin palp femur, 3.3 X longer than wide (VM, 2013; figs. 128, 129)…..……………………….……….......*Ixchela grix* **Valdez-Mondragón**

Females

1. Epigynum considerably longer than wide (VM, 2013; figs. 41, 95, 119)………………….…….**2**

– Epigynum as long as wide, or slightly wider than long (Figs 42, 53)…………………….……..**5**

2 (1). Epigynum with a single long apophysis or without apophysis (VM, 2013; figs 121, 185)...
…………………………………………………………………………………………**3**

– Epigynum with paired apophyses (VM, 2013; figs 39, 95)...**4**

3 (2). Epigynum with a ventral apophysis, very long, curved and conical (VM, 2013; figs 118-121); without pale region and without a concavity in posterior part (VM, 2013; figs 119, 121)…
………..*Ixchela juarezi* **Valdez-Mondragón**

– Epigynum without apophysis, pear-shaped in ventral view (VM, 2013; fig. 183), with a small pale region in posterior part (VM, 2013; fig. 183), with a posterior concavity in lateral view (VM, 2013; arrow, Fig. 185)………..………..….*Ixchela santibanezi* **Valdez-Mondragón**

4 (2). Epigynum wider anteriorly, with VAE close together (VM, 2013; figs. 43, 44); VAE in anterior part, without rounded protuberance (VM, 2013; figs. 39, 41, 43, 44)……………………
………………….…………………………….………..….*Ixchela furcula* **(F. O. Pickard-Cambridge)**

– Epigynum wider medially, with VAE separated from each other (VM, 2013; fig. 94); VAE on anterior rounded protuberance (VM, 2013; figs. 94, 95, 97)......………………..…………….
……………………………………………………......….*Ixchela mixe* **Valdez-Mondragón**

5 (1). Epigynum with a conspicuous conical apophysis medially (Figs 41, 52)……………….….**6**

– Epigynum without a conspicuous apophysis (VM, 2013; figs 30, 71, 145, 158, 172)…...**11**

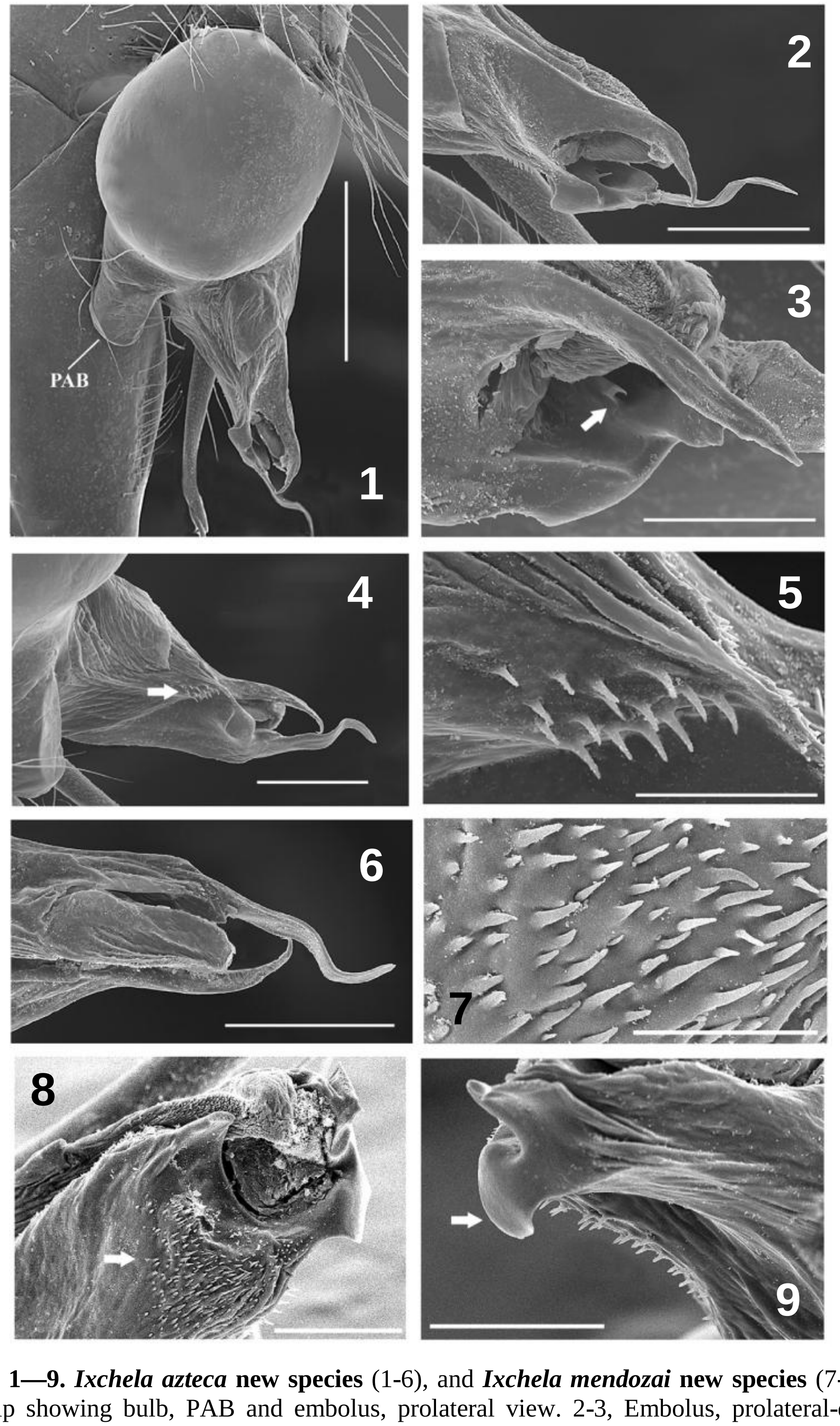
6 (5). Epigynum triangular in ventral view (VM, 2013; fig. 82)………………....……………...
……………………………......................................*Ixchela simoni* **(O. Pickard-Cambridge)**

– Epigynum subquadrate in ventral view (VM, 2013; fig. 56)..**7**

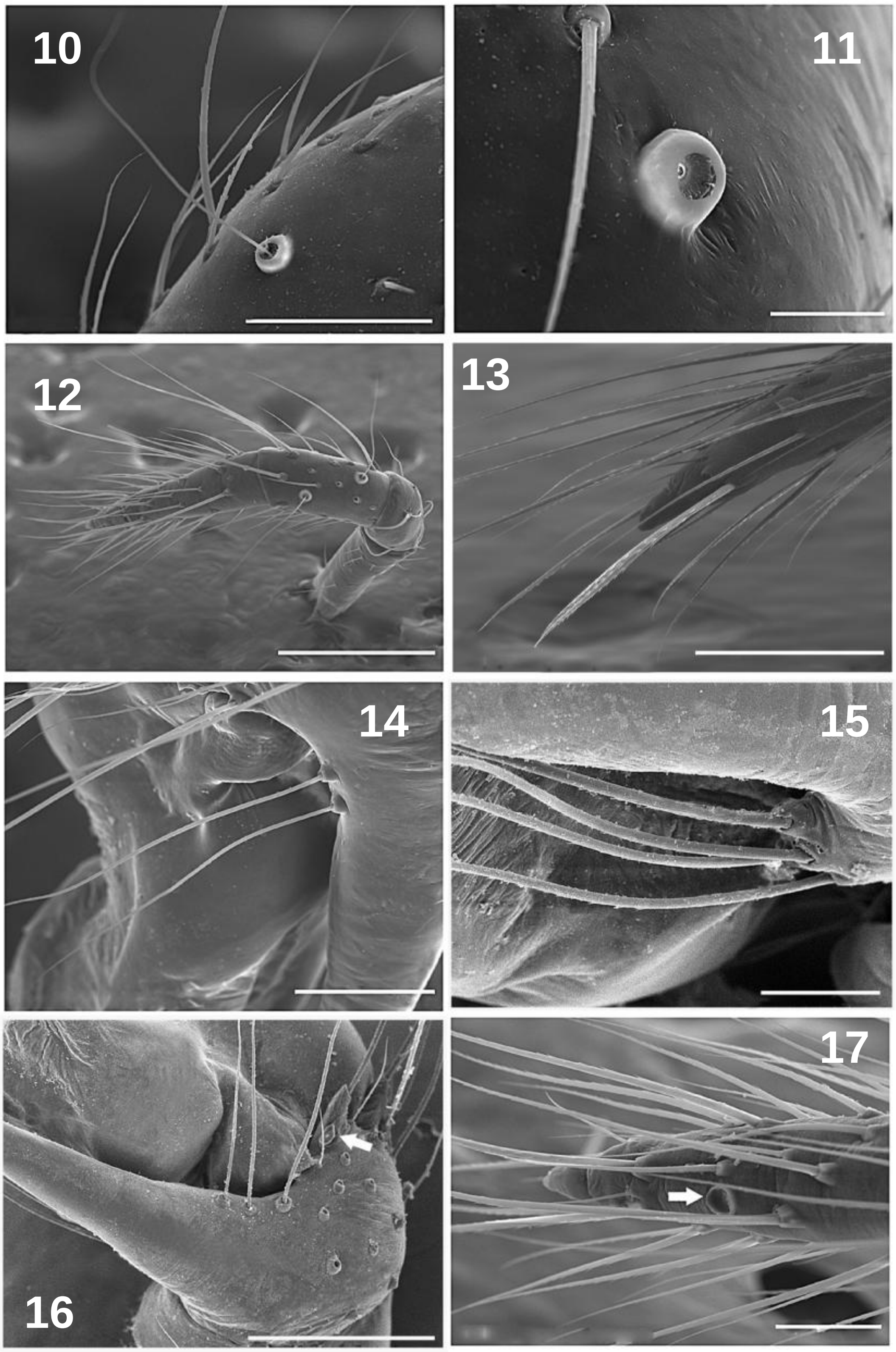
7 (6). Epigynum triangular, pointed in frontal view (VM, 2013; fig. 210)……...………………**8**

– Epigynum subquadrate, blunt in frontal view (VM, 2013; fig. 58)…………………...……..

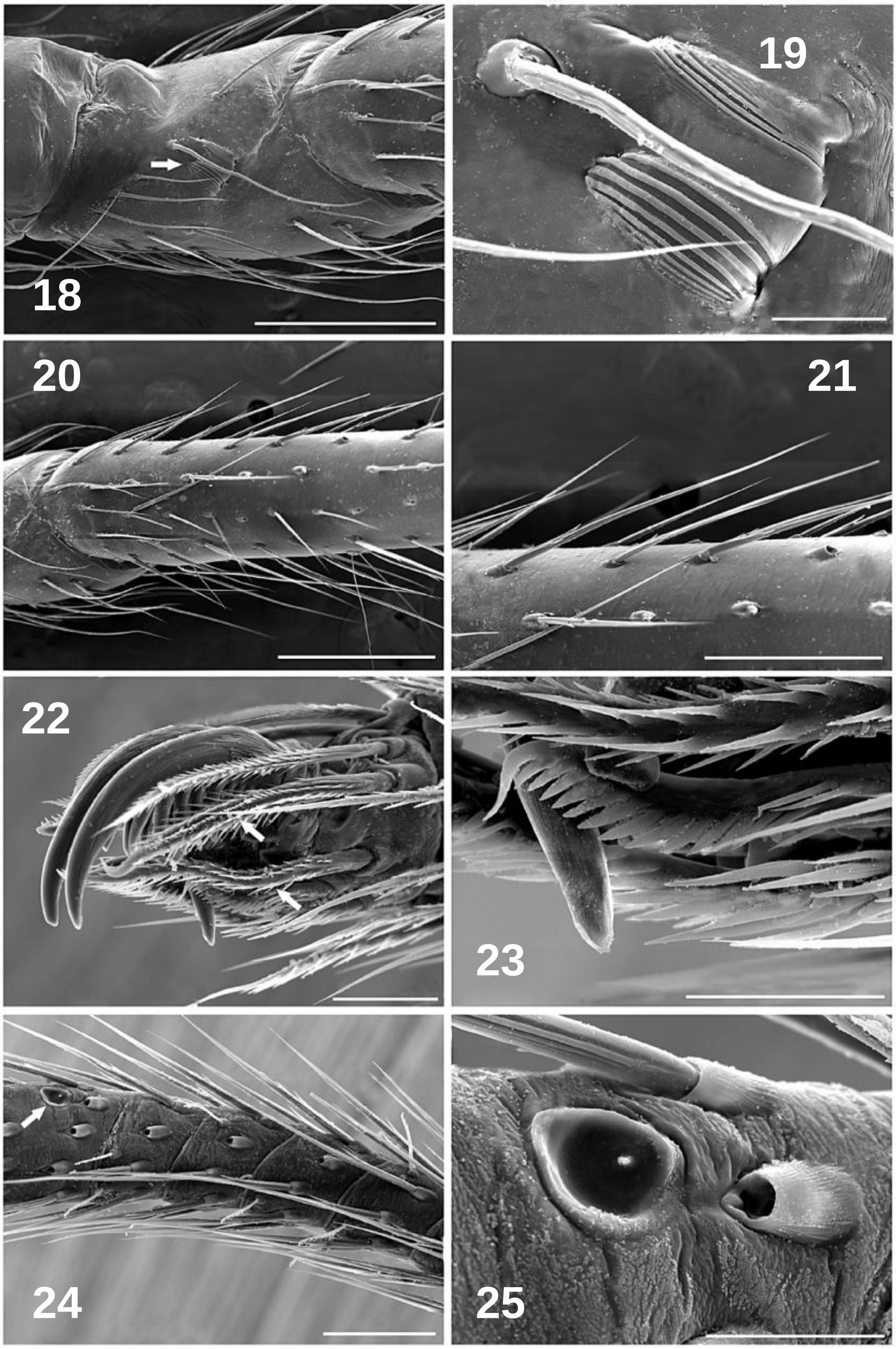
……………………………………………………….………..……*Ixchela pecki* **(Gertsch)**
8 (7). Epigynum with PP longer than wide (VM, 2013; fig. 212)...…………………….………
……………………………………...……………..….*Ixchela viquezi* **Valdez-Mondragón**
– Epigynum with PP wider than long (Figs 43, 54)………………………....……….…...**9**
9 (8). Epigynum in frontal view with lateral rounded protuberances, slightly conspicuous or conspicuous (Figs 55, 67)……………………………..……………………………...…**14**
– Epigynum in frontal view without lateral rounded protuberances (VM, 2013; figs 106, 130)……………………………………………………………………………………...**10**
10 (9). Epigynum with apophysis on anterior part (VM, 2013; figs 131, 133)…….………….....
……………………………….…………………….…..….*Ixchela grix* **Valdez-Mondragón**
– Epigynum with apophysis medially (VM, 2013; figs 107, 109)...………..……..................
………………………………...……………………..….*Ixchela huberi* **Valdez-Mondragón**
11 (5). Epigynum with small and circular concavity, in frontal-distal part (VM, 2013; figs 142, 159)…………………………………………………………………………...……**12**
– Epigynum without small and circular concavity (VM, 2013; fig. 169)..........................**13**
12 (11). Epigynum higher than wide in frontal view (VM, 2013; fig. 142); epigynum with anterior two-thirds dark, posterior third pale (VM, 2013; fig. 143)………………………………
……………………..……...…..……………..………..*Ixchela taxco* **Valdez-Mondragón**
– Epigynum wider than high in frontal view (VM, 2013; fig. 159); epigynum with anterior half pale and distal half dark (VM, 2013; fig. 155)….…...*Ixchela franckei* **Valdez-Mondragón**
13 (11). Epigynum in frontal view with posteromedian area not extending beyond posterior margin (VM, 2013; fig. 169); epigynum without small, rounded pit on posteromedian area (VM, 2013; figs 169, 170); epigynum trapezoidal in ventral view, wider distally than basally (VM, 2013; fig. 170)………………….……………………...…..*Ixchela tzotzil* **Valdez-Mondragón**
14 (11). Epigynum in frontal view with slightly conspicuous lateral rounded protuberances (Figs 44, 55).…………………..………………………………………………………….............**15**
– Epigynum in frontal view with conspicuous lateral rounded protuberances (Figs 67, 78)…
……………………………………………………………………………………………..**17**
15 (14). Epigynum with ventral apophysis pointed distally (Figs 41, 52)…….….……………**16**
– Epigynum with ventral apophysis rounded distally (VM, 2013; figs. 198, 201)………...
…………………………………………………..……..*Ixchela huasteca* **Valdez-Mondragón**
16 (15). Epigynum with ventral apophysis curved and located on anterior part (Fig. 41)………..
……………………………………………………...……………..*Ixchela azteca* **new species**
– Epigynum with ventral apophysis almost straight and located on median part (Fig. 52)..
…………………………………………………………………*Ixchela jalisco* **new species**
17 (14). Epigynum in lateral view, with a conspicuous and long ventral apophysis (Fig. 75)……
……………………………………………………………………………………………..**18**
– Epigynum in lateral view, with an inconspicuous and short ventral apophysis (VM, 2013; figs 30, 71)……..………………………………………………………………………….…**19**
18 (17). Epigynum in lateral view, with ventral apophysis thin and pointed apically (Fig. 75)………………………………………………..…..……*Ixchela purepecha* **new species**
– Epigynum in lateral view, with ventral apophysis wide and rounded apically (Figs 66, 86)...…………………………………………………………………………………………..**20**
19 (17). Epigynum in frontal view, with distal margin concave (VM, 2013; fig. 68); epigynum with two prominent lateral, rounded protuberances (VM, 2013; figs 68, 69, 71)…………………
…………………...…………………………………….………...….*Ixchela placida* **(Gertsch)**
– Epigynum in frontal view, with posteromedian area extending beyond posterior margin (VM, 2013; fig. 27); epigynum with two weak, lateral rounded protuberances (VM, 2013; figs. 27, 28, 30)……………………….………..………..…..….*Ixchela abernathyi* **(Gertsch)**
20 (17). Epigynum in lateral view wide and almost straight (Fig. 86); in dorsal view, MSE not touching the PP (Fig. 88).………………………….……..…………..*Ixchela tlayuda* **new species**
– Epigynum in lateral view very wide and slightly curved (Fig. 66); in dorsal view, MSE touch the PP (Fig. 65)………..……………………………...……*Ixchela mendozai* **new species**



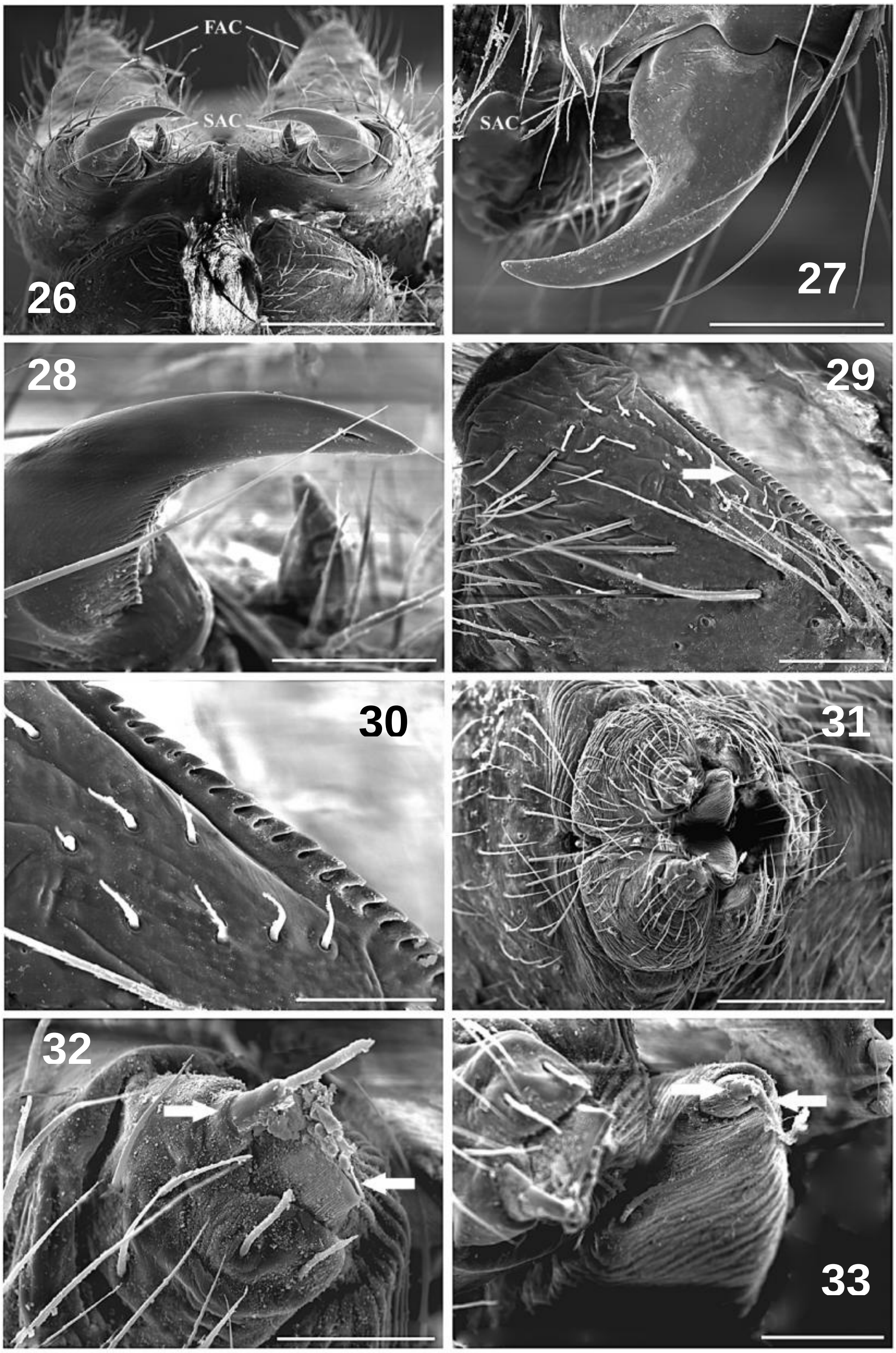
Figures 1—9. ***Ixchela azteca*** **new species** (1-6), and ***Ixchela mendozai*** **new species** (7-9). 1, Left palp showing bulb, PAB and embolus, prolateral view. 2-3, Embolus, prolateral-dorsal view (arrow indicates the spine on sperm operculum). 4, 6, Embolus, prolateral and retrolateral views respectively (arrow indicates the projections spines-shaped). 5, 7, Detail of the spine-shaped projections on embolus. 8, Embolus, distal view (arrow indicates the spine-shaped projections). 9, Embolus, retrolateral view (arrow indicates the sub-distal, sclerotized spine). Scales: 30 µm (Fig. 7), 50 µm (Fig. 5), 100 µm (Figs 3, 8, 9), 200 µm (Figs 2, 4, 6), 500 µm (Fig. 1).



Figures 10—17. ***Ixchela jalisco*** **new species** (10-14, 17), and ***Ixchela mendozai*** **new species** (15, 16). 10, Trichobothria of the tibia, male palp. 11, Trichobothria socket, detail. 12, Female left palp, showing trichobothrium on tibia. 13, Female left palp, detail of setae on tarsus. 14, Male palp, detail of basal setae on dorsal area of procursus. 15, Setae on ventrobasal protuberance of procursus. 16, Procursus basal part (arrow indicates the tarsal organ exposed). 17, Female left palp (arrow indicates the tarsal organ). Scales: 50 µm (Fig. 11), 100 µm (Figs 15, 17), 200 µm (Figs 10, 14), 300 µm (Figs 13, 16), 500 µm (Fig. 12).



Figures 18—25. *Ixchela azteca* new species. Male. 18, Left patella IV, ventral view (arrow indicates the lyriform organs). 19, Left patella IV, detail of the lyriform organs. 20, Left tibia IV, basal part, ventral view. 21, Tibia IV, detail of the setae. 22, Left tarsus IV, retrolateral view (arrows indicate the comb-hairs). 23, Left tarsus IV, detail of the median claw and comb-hairs. 24, Left tarsus IV, detail of the pseudosegments (arrow indicates the tarsal organ). 25, Left tarsus IV, detail of the tarsal organ and setae socket. Scales: 30 µm (Fig. 23, 25), 50 µm (Fig. 19, 22), 100 µm (Fig. 24), 300 µm (Fig. 21), 400 µm (Fig. 18), 500 µm (Fig. 20).



Figures 26—33. *Ixchela azteca* new species. Male. 26, Chelicerae, ventral view. 27, Left chelicerae, frontal view. 28, Right chelicerae, posterior view. 29, Left endite, ventral view (arrow indicates the serrated margin). 30, Detail of the serrated margin. 31, Spinnerets, ventral view. 32, Detail of one anterior lateral spinneret (arrows indicates the slightly pointed spigot and the wide spigot). 33, Detail of one posterior median spinneret (arrows indicate the acciniform gland spigots). Scales: 50 µm (Figs 30, 32, 33), 100 µm (Figs 28, 29), 200 µm (Fig. 27), 300 µm (Fig. 31), 500 µm (Fig. 26).

IXCHELA AZTECA new species
(Figs 34-44)

Type data. MEXICO: Estado de México: 1 ♂ holotype (CNAN T0763) [26 August 2011; A. Valdez, J. Mendoza, D. Barrales, R. Monjaraz, E. Miranda] from Km 46 highway Toluca-Valle de Bravo (lat 19.2560°, lon -100.0669°; 2315 m). Paratypes: 1 ♀ (CNAN T0764); 1 ♀, 3 immatures (CNAN T0765), same data as holotype.

Material examined. MEXICO: *Estado de México:* 3 ♀♀ (1 with egg sac) (CNAN) [28 April 2011; A. Valdez, O. Francke, J. Cruz, R. Monjaraz, E. Miranda] from Km 34 highway Toluca-Zitácuaro (lat 19.3687°, lon -100.0241°; 2730 m). 1 ♂, 1 immature (CNAN) [27 August 2011; A. Valdez, J. Mendoza, D. Barrales, R. Monjaraz, E. Miranda] from Cueva del Diablo, La Peña (next to the Microwave Station) (lat 19.2006°, lon -100.1414°; 1885 m), Valle de Bravo, Municipio Valle de Bravo. 1 ♀ (with egg sac) (CNAN) [26 August 2011; A. Valdez, J. Mendoza, D. Barrales, R. Monjaraz, E. Miranda] from km 46 highway Villa Victoria-Valle de Bravo (lat 19.2560°, lon -100.0669°; 2315 m). 4 immatures (CNAN) [26 August 2011; A. Valdez, J. Mendoza, D. Barrales, R. Monjaraz, E. Miranda] from Reserva Estatal Monte Alto (lat 19.1930°, lon -100.1122 °; 2152 m), Municipio Valle de Bravo. 2 ♂♂, 1 immature (CNAN) [27 August 2011; A. Valdez, J. Mendoza, D. Barrales, R. Monjaraz, E. Miranda] from Cueva de Peña Blanca inside of Rancho La Mecedora (near to Casas Viejas) (lat 19.1325°, lon -100.1051°; 2149 m), Municipio Valle de Bravo. *Distrito Federal:* 1 ♂, 3 ♀♀ (AMNH) [28 February 1973; J. Reddell, D. McKenzie, M. McKenzie, M. Butterwick] from Cueva de Cerro de la Estrella, 2 km S of Iztapalapa (~lat 19.3267°, lon -99.0918°; 2273 m), Delegación Iztapalapa. 1 ♂ (CNAN) [13 July 1986; L. M. Ruíz] from Kinchil Mza. 168, Lt. 5, Colonia Heroes de Padierna (~lat 19.2831°, lon -99.2216°; 2532 m), C. P. 14200, Delegación Tlalpan. 1 ♂ (male grown in the laboratory until the 6th. moult), 3 ♀♀ (CNAN) [25 June 2009; A. Valdez, H. Montaño, R. Paredes, T. Garrido] from road to Cueva del Fraile (lat 19.5876°, lon -99.1309°; 2614 m), Delegación Gustavo A. Madero. 1 ♂, 1 immature (CNAN) [25 June 2009; A. Valdez, H. Montaño, R. Paredes] from Cueva del Fraile (lat 19.5938°, lon -99.1283°; 2810 m), Delegación Gustavo A. Madero. 1 ♂ (CNAN) [25 January 2013; V. Reyes] from Instituto de Biología, UNAM, Cd. Universitaria (lat 19.3205°, lon -99.1945°; 2327 m), Delegación Coyoacán. *Guerrero:* 3 ♀♀, 3 immatures (CNAN) [4 June 2010; A. Valdez. O. Francke, J. Cruz, D. Barrales] from 5 km W of Casahuates (lat 18.5874°, lon -99.6268°; 2275 m), Municipio Taxco de Alarcón. *Michoacán:* 2 ♀♀ (CNAN) [28 April 2011; A. Valdez, O. Francke, J. Cruz, R. Monjaraz, E. Miranda] from El Naranjo (lat 19.4017°, lon -100.3551°; 2113 m), Municipio Zitácuaro. 2 ♀♀ (CNAN) [26 November 2012; D. Ortiz, E. Hijmensen, E. Goyer] from 7 km SE of Ciudad Hidalgo (lat 19.6347°, lon -100.4828°; 1750 m), Municipio Ciudad Hidalgo. 1 ♂, 5 ♀♀, 7 immatures (CNAN) [29 April 2011; A. Valdez, O. Francke, J. Cruz, R. Monjaraz, E. Miranda] from Gruta de Tziranda (lat 19.6400°, lon -100.5021°; 1855 m), Municipio Ciudad Hidalgo. *Morelos:* 1 ♀ (AMNH) [14 April 1940; C. Bolivar, D. Pelaez] from Parque Nacional de Zempoala. 1 ♀ (CNAN) [21 May 1978; C. Valdez] from Cueva del Diablo or Ostoyehualco (lat 18.9952°, lon -99.0601°; 1947 m), Municipio Tepoztlán. 1 ♀ (CNAN) [21 May 1978; M. M. Oran?], same locality. 5 ♀♀, 2 immatures (CNAN) [4 December 1977; I. Vázquez], same locality. 2 immatures (CNAN) [2 July 1978; M. Ortiz], same locality.2 ♂♂ (CNAN) [20 December 1977; M. Morales], same locality. 1 ♂ (CNAN) [4 December 1977; M. Morales], same locality. 1

♀ (CNAN) [23 May 1978; M. S. Trejo], same locality. 1 immature (CNAN) [21 May 1978; G. Borja], same locality. 2 ♂♂, 5 ♀♀, 33 immature (CNAN) [29 July 2009; A. Valdez, O. Francke, C. Santibáñez, T. Palafox, C. Trujano], same locality. 1 ♀ (CNAN) [25 January 1978; J. Gutierrez] from Tepozteco, Municipio Tepoztlán. 1 immature (CNAN) [5 June 1981; V. A. Guillermina] from km 8 road Amatlán Santo Domingo, Municipio Tepoztlán.

Etymology. The specific name is a noun in apposition and is dedicated to the Aztecs, a Mesoamerican culture in central part of Mexico (about the years 1428 to 1521), where most of the localities reported for this species are located.

Diagnosis. Resembles *I. abernathyi* and *I. simoni*, distinguished from *I. abernathyi* by the FAC wider and longer (Figs 37, 40); by palp femur wider and curved ventrally (Figs 38, 39); by the larger, curved, and conical epigynum (Figs 41, 44); by the MSE complete, posteriorly touching the PP (Fig. 43); and by the carapace with larger brown spots on each side (Fig. 35); by the fovea with straight and wider brown spot around it (Fig. 35); and by legs without numerous color rings; from *I. simoni* by the FAC conical (Fig. 40); by the having SAC developed (Fig. 37); by the shorter PAB (Figs 38, 39); by the palp femur more curved ventrally (Figs 38, 39); by the epigynum longer and curved (Figs. 41); by the PP wider than long (Fig. 43); and by the oval concavities between MSE and PP more visible (Fig.43).

Description. Male (Holotype). Prosoma: Carapace beige, with one pale brown spots each side (Fig. 35). Fovea with irregular, wide and pale brown spot around it, which is joined with the ocular region (Fig. 35). Ocular region dark brown, with a wide line from anterior median eyes to posterior part of the ocular region, one thin brown line from each posterior median eye to posterior part of the ocular region (Fig. 35). Clypeus brown, darker distally (Fig. 36). Chelicerae brown, paler in prolateral proximal part and around of the sclerotized apophysis of chelicerae (Fig. 37). Sternum pale orange. Labium and endites brown, white apically. *Legs:* Coxae pale yellow, gray distally in prolateral and retrolateral parts. Trochanters brown. Femora brown, with a marked width ring sub-distally; femur IV paler that the others. Patellae dark gray. Tibiae, metatarsi and tarsi pale brown. Tibiae with a dark ring basally and other one distally. *Opisthosoma:* Conical, pale blue, larger than high (Figs 34, 35). Gonopore plate olive, oval. *Palp:* Femur orange, conical, paler ventrally, with wide VAF (Figs 38, 39). Patellae and tibia orange. Procursus brown, conical, paler basally, with curved and thin spine distally (Fig. 38). VPP rounded, with numerous long setae (Fig. 38). Embolus conical, with curved dorsal-distal spine, ventrally with sclerotized, long, and curved projection (Figs 38, 39). *Measurements:* Total length (prosoma+opisthosoma) 8.25. Carapace 3.10 long, 2.85 wide. Clypeus 1.20 long. Diameter AME 0.14, ALE 0.24, PME 0.18, PLE 0.23. Distance ALE-PME 0.18, PME-PME 0.34. Leg I: 49.42 (femur 13.62 + patella 1.30 + tibia 13.00 + metatarsi 16.00 + tarsi 5.50). tibia II: 9.37, tibia III: 7.70, tibia IV: 9.50; tibia I (length/diameter) (l/d) 26.00.

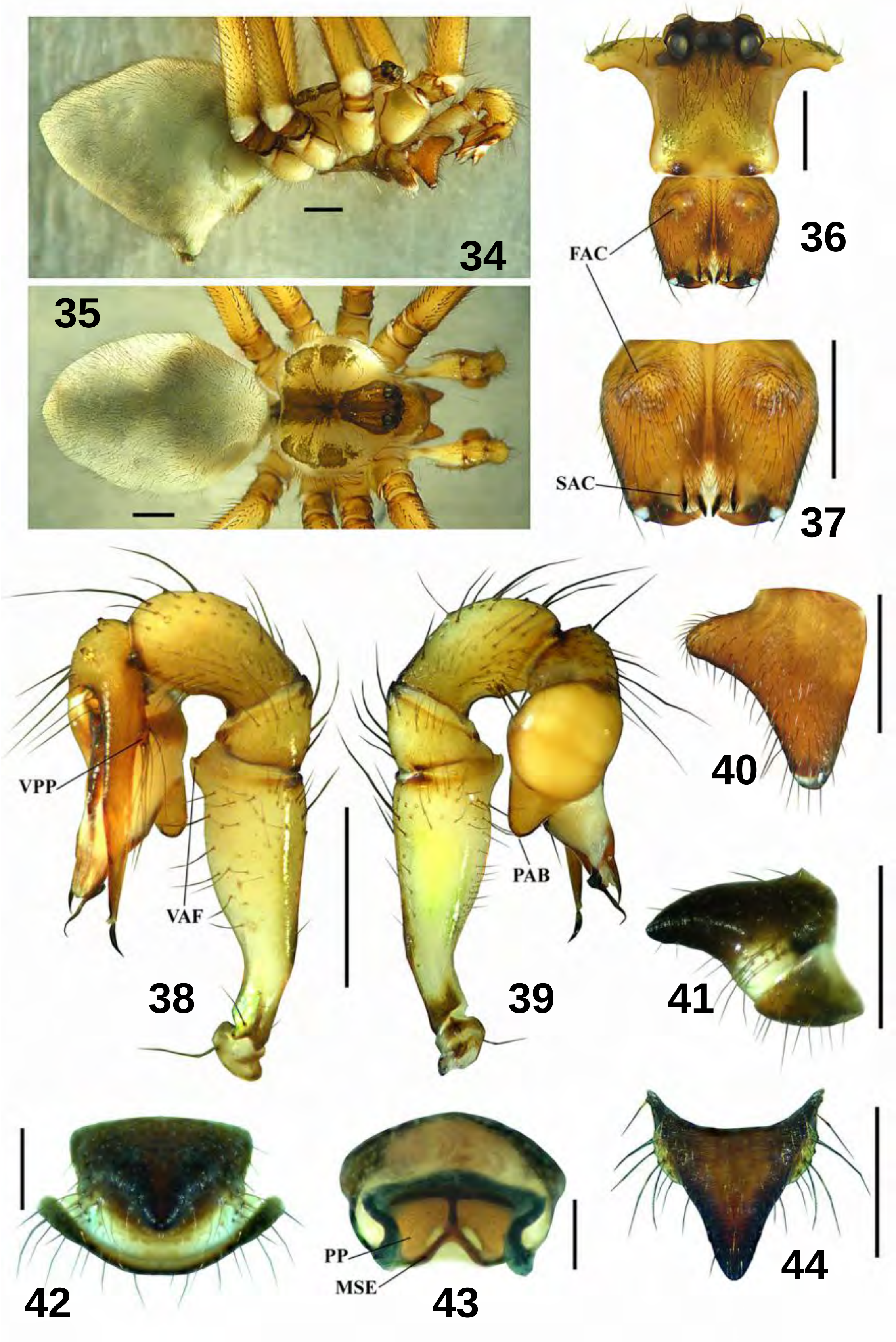
Female (Paratype). (CNAN T0764). Similar to the male, differences: *Prosoma:* Carapace with brown spots each side darker than the male. Fovea with brown spot around it, darker than on male. Ocular region with inconspicuous lines. Clypeus darker brown than the male. Chelicerae darker brown than the male. Sternum, labium and endites darker brown than the male. *Legs:* Femora darker brown than the male. *Epigynum:* Wider than long (Fig. 42). PP wide, with MSE strongly sclerotized (Fig. 43).

Oval concavities between MSE and PP, sac-shaped (Fig. 43). *Measurements:* Total length 8.00. Carapace 3.10 long, 3.00 wide. Clypeus 1.15 long. Diameter AME 0.13, ALE 0.25, PME 0.20, PLE 0.24. Distance ALE-PME 0.16. PME-PME 0.30. Leg I: 44.19 (11.56+1.23+12.00+14.50+4.90), tibia II: missing, tibia III: 6.70, tibia IV: 8.60; tibia I l/d 25.40.

Variation. There is discontinuous variation in the size of the specimens from the different localities, even in each locality there was discontinuous variation within males and females. Male specimens from Cueva del Diablo or Ostoyehualco and from Gruta de Tziranda were notably smaller than specimens from type locality and the other localities. Female specimens from Grutas de Tziranda and Road to Cueva del Fraile were notably smaller than specimens from the other localities. Specimens from Cueva del Diablo have paler coloration on carapace and legs than the other specimens. There was variation in the opisthosomal coloration: gray, pale gray, blue, or pale blue. *Males:* Cueva del Diablo or Ostoyehualco (N= 4), tibia I: 10.87-12.50 (x= 11.74). Cueva del Diablo, La Peña (N= 1): tibia I: 18.12. Cueva de Peña Blanca (N = 2), tibia I: 13.75, 14.00. Gruta de Tziranda (N= 1): tibia I: 11.00. Road to Cueva del Fraile and Cueva del Fraile respectively (N= 2): tibia I: 9.50, 12.25. *Females:* Cueva del Diablo or Ostoyehualco (N= 7): tibia I: 7.50-16.00 (x= 12.77). Km 34 highway Toluca-Zitácuaro (N= 3): tibia I: 6.60-12.5 (x= 9.50). 5 km W of Casahuates (N= 3): tibia I: 9.37-15.25 (x= 11.95). El Naranjo (N= 2): tibia I: 9.50, 11.75. 7 km SE of Ciudad Hidalgo (N= 2): tibia I: 9.7, 11.37. Gruta de Tziranda (N= 4): tibia I: 7.10-10.2 (x= 8.70). Road to Cueva del Fraile (N= 2): tibia I: 10.12, 11.87.

Natural History. Specimens from Estado de México and Guerrero were collected on their sheet webs in an oak-pine and pine forest, on walls along road-cuts in wet and shaded areas covered with roots. The male collected in the Instituto de Biología, UNAM, was collected walking on a wall. The specimens collected from Cueva del Fraile, Distrito Federal, and Gruta de Tziranda, Michoacán, were collected on their sheet webs inside the caves, close to the walls. Specimens collected outside the Cueva del Fraile were on the other hand collected among boulders in shady moist areas, whereas specimens from Cueva del Diablo or Ostoyehualco were collected in the cave entrance and inside the cave, where humidity was ca 70% and it was cold. The specimens were collected on their sheet webs, and it was very common to find prey remains in their webs, mainly of big leafcutter ants of the genus *Atta* (subfamily Myrmicinae), the ants are a readily available food source for the spiders; which could also explain the high density of the spiders inside the cave.

Distribution. MEXICO: Estado de México, Distrito Federal, Guerrero, Michoacán, Morelos (Fig. 90).



Figures 34—44. *Ixchela azteca* new species. Male: 34-35, Habitus, lateral and dorsal views respectively. 36, Carapace, frontal view. 37, Chelicerae, frontal view. 38-39, Left palp, retrolateral and prolateral views respectively. 40, Chelicera, lateral view. Female: 41, Epigynum, left lateral view. 42, Epigynum, ventral view. 43, Epigynum, dorsal view. 44, Epigynum, frontal view. Scales: 0.5 mm (Figs 42, 43), 1 mm (Figs 34-41, 44).

IXCHELA JALISCO new species

Figs 45-55

Type data. MEXICO: Jalisco: 1 ♂ holotype (CNAN T0751) [21 July 2012; A. Valdez, O. Francke, D. Barrales, G. Contreras] from 8 km S of Cerro de la Tetilla (lat 20.367°, lon -105.020°; 2441 m), Municipio Talpa de Allende. Paratypes: 1 ♀ (with egg sac) (CNAN T0752) [21 July 2012; A. Valdez, O. Francke, D. Barrales, G. Contreras] from Cerro de la Tetilla (lat 20.365°, lon -104.993°; 2427 m), Municipio Talpa de Allende. 4 ♀♀, 1 immature (CNAN T0753) [19 July 2012; A. Valdez, O. Francke, D. Barrales, G. Contreras] from 1.5 km road to Área Natural Protegida Piedras Bola (lat 20.647°, lon -104.037°; 1877 m), Municipio Ahualulco del Mercado. 1 immature (CNAN T0754) [17 July 2012; A. Valdez, O. Francke, D. Barrales, G. Contreras] from Área Natural Protegida Piedras Bola (lat 20.651°, lon -104.057°; 1880 m), Municipio Ahualulco del Mercado.

Etymology. The specific name is a noun in apposition and refers to the state where the type locality is: Jalisco, Mexico.

Diagnosis. Distinguished from congeners by the chelicerae with long and conical FAC, slightly projected dorsally and slightly curved apically (Figs 48, 51); by the palp femur markedly curved ventrally, being thinner basally and wider distally (Figs 49, 50); by the VAF big, conical and claw-shaped (Figs 49, 50); and by the epigynum with long and conical apophysis (Figs 52, 53, 55).

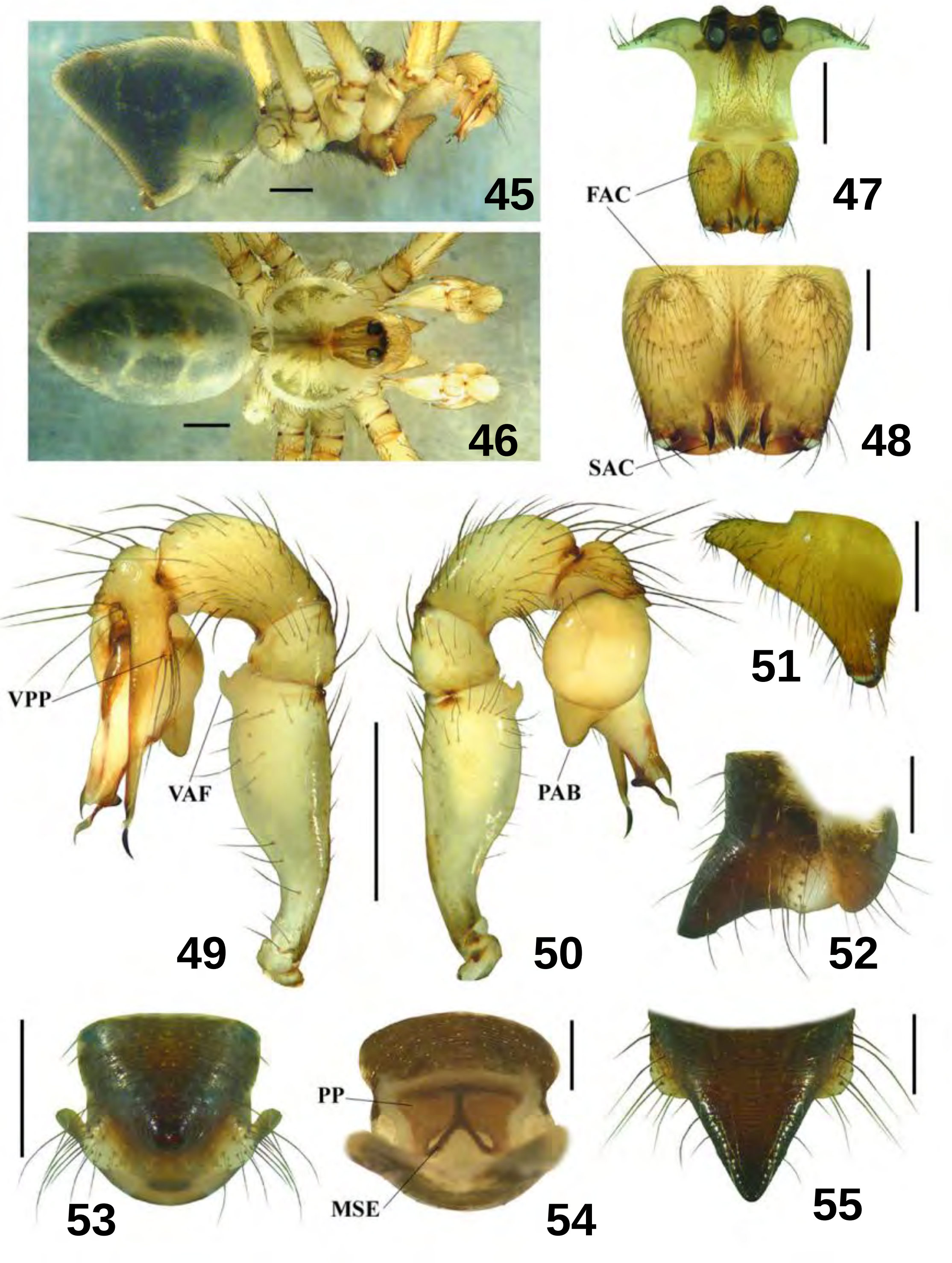
Description. Male (Holotype). Prosoma: Pale yellow, with wide and long pale gray pattern on each side (Fig. 46). Ocular region pale yellow, with a wide pale gray line projected from AME toward posterior region, and other lines thinner and shorter projecting from PME toward posterior region (Fig. 46). Fovea surrounded by an irregular, pale gray region (Fig. 46). Clypeus pale yellow, with small pale gray region near to chelicerae (Fig. 47). Chelicerae pale brown, paler around the SAC and basally (Fig. 48). Sternum, labium and endites olive green. Endites distally white. *Legs:* Coxae white, olive green distally on retro and prolateral part. Trochanters olive green. Femora pale orange, without numerous color rings, only one gray ring sub-distally. Patellae gray. Tibiae pale orange, without numerous color rings, only one basal and one sub-distal. Metatarsi and tarsi orange, without color rings. Legs with numerous oblique, long setae; and with few, short vertical setae. *Opisthosoma:* Conical, longer than high, blue, with gray pattern dorsally (Figs 45, 46). Gonopore plate oval, olive green. *Palp:* Femur pale yellow, slightly gray dorsally (Figs 49, 50). VAF claw-shaped. Patella and tibia pale gray. Procursus pale gray on basal half and brown on distal half, with distal spine (Fig. 49). VPP small, with setae of different sizes (Fig. 49). Embolus conical, dorsally with small, curved spine (Figs 49, 50); ventrally with long, sigmoid projection on distal part (Figs 49, 50). PAB conical (Fig. 50). *Measurements:* Total length 8.00. Carapace 3.25 long, 2.85 wide. Clypeus 1.20 long. Diameter AME 0.14, ALE 0.24 PME 0.19, PLE 0.22. Distance ALE-PME 0.22, PME-PME 0.32. Leg I: 56.52 (15.00+1.40+14.87+18.75+6.50), tibia II: 10.75, tibia III: 8.75, tibia IV: 10.87. Tibia I l/d: 29.50.

Female (Paratype). (CNAN T0752). Similar to male, differences: *Prosoma:* The dorsal pattern on each side darker gray than on male. Ocular region uniformly brown, with inconspicuous lines projected from AME and PME. The irregular region surrounding the fovea darker gray than on male. Clypeus with wide, brown longitudinal band. Chelicerae darker brown than on male. Sternum, labium and endites dark brown. *Legs:* The distal part of retro and prolateral faces of coxae dark brown. Trochanters dark brown. Femora brownish, paler basally. Tibiae, metatarsi and tarsi dark orange. *Epigynum:* Wider and higher than long (Fig. 53). PP curved laterally (Fig. 54), with oval, long sac-shaped concavities between MSE and PP (Fig. 54); MSE with upside down Y-shape (Fig. 54). *Measurements:* Total length 8.70. Carapace 3.65 long, 3.50 wide. Clypeus 1.30 long. Diameter AME 0.16, ALE 0.26, PME 0.20, PLE 0.23. Distance ALE-PME 0.21. PME-PME 0.36. Leg I: 54.74 (14.81+1.50+14.81+18.00+5.62), tibia II: 10.60, tibia III: 8.65, tibia IV: 10.85; tibia I l/d 26.44.

Variation. There is continuous variation in size among females. The smallest females have variation in coloration, with carapace and legs orange; whereas the largest females have carapace pale yellow and legs reddish. There is variation in the coloration of the ocular region, dorsal pattern on carapace and clypeus pattern; ranging from pale brown to dark brown. Female tibia I: 10.25-12.60 (x= 11.03).

Natural History. The specimens were collected in a mixed oak-pine forest, the holotype was collected under dry leaves of an agave plant; a microhabitat with high humidity. The paratypes were collected on their sheet webs on walls along road-cuts, covered with roots and leaf-litter with high humidity, and among fallen logs and boulders on the ground.

Distribution. MEXICO: Jalisco (Fig. 90).



Figures 45—55. ***Ixchela jalisco*** **new species**. Male: 45-46, Habitus, lateral and dorsal views respectively. 47, Carapace, frontal view. 48, Chelicerae, frontal view. 49-50, Left palp, retrolateral and prolateral views respectively. 51, Chelicera, lateral view. Female: 52, Epigynum, left lateral view. 53, Epigynum, ventral view. 54, Epigynum, dorsal view. 55, Epigynum, frontal view. Scales: 0.5 mm (Figs 48, 51, 52, 54, 55), 1 mm (Figs 45-47, 49, 50, 53).

IXCHELA MENDOZAI new species
Figs 56-67

Type data. MEXICO: Puebla: 1 ♂ holotype (CNAN T0749) [24 February 2012; A. Valdez, C. Santibáñez, J. Mendoza, D. Barrales, A. Ortega] from Campamento Ecoturístico, Cañadas Rojas, Puente Colorado (lat 18.683°, lon -97.345°; 2231 m), Municipio Chapulco. Paratypes: 2 ♀♀ (CNAN T0750), same data as holotype.

Etymology. The specific name is a noun in apposition and dedicated to arachnologist Jorge Iván Mendoza Marroquín for his participation in collecting the type series.

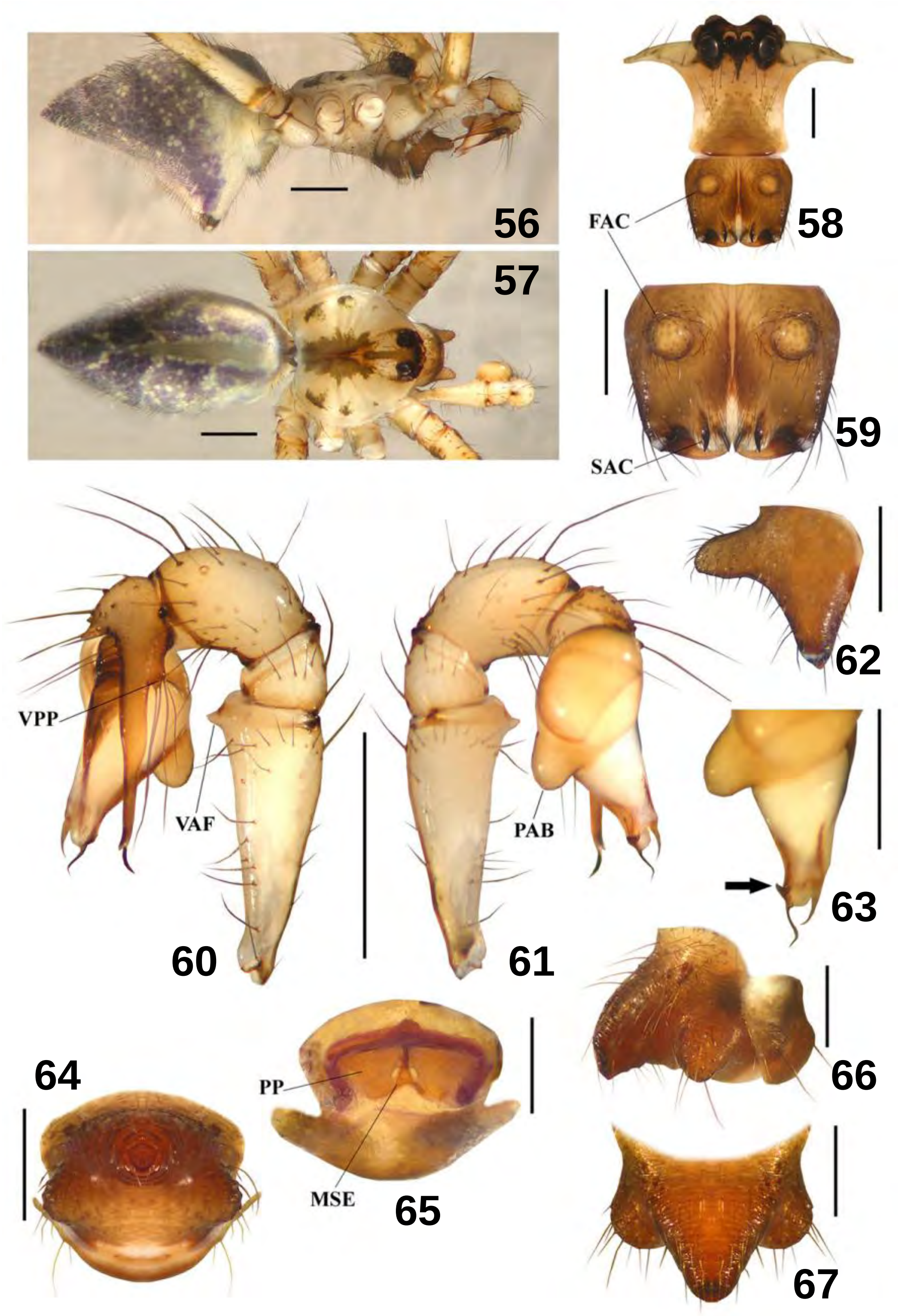
Diagnosis. Resembles *I. tlayuda*, distinguished by the FAC long and rounded, forming an angle of 90° with the chelicerae in lateral view (Fig. 62); by the VAF with sharp tip (Fig. 60); by the long, curved and sharp sub-distally sclerotized spine on ventral part of embolus (arrow, Fig. 63); and by the epigynum with three projections apically, the central markedly longer and curved, the lateral ones small and rounded (Figs 64, 66, 67).

Description. Male (Holotype). Prosoma: Pale yellow, with three brown spots on each side (Fig. 57). Ocular region pale yellow, with a brown longitudinal line projecting from AME (Fig. 57). Fovea surrounded with an irregular, wide brown region, extending backward (Fig. 57). Clypeus pale yellow, with a wide brown region near chelicerae (Fig. 58). Chelicerae brown, pale around the SAC (Fig. 59). Sternum pale yellow. Labium and endites brown; endites with retrolateral apophysis, which has a small subdistal protuberance. *Legs:* Coxae pale yellow, with small brown spots on retrolateral and prolateral parts. Trochanters pale yellow. Femora pale orange, with several brown rings throughout their length, one sub-distal ring dark brown, wide, very marked. Patellae brown. Tibiae pale orange, with several brown rings throughout their length, less visible than on femora. Metatarsi and tarsi orange, without color rings. Legs with numerous oblique, long setae; with few short, vertical setae. *Opisthosoma:* Conical, longer than high, pale blue, with dorsal gray pattern (Figs 56, 57). Gonopore plate oval. *Palp:* Femur pale yellow, conical, with several long setae ventrally; VAF conical, with sharp tip (Figs 60, 61). Patella and tibia pale orange. Procursus brown, long and straight, with distal spine, thin and curved (Figs 60, 61). VPP with 3-4 long setae (Fig. 60). Embolus conical, dorsally with a curved spine (Figs 60, 61), ventrally with apical sigmoid projection (Figs 60, 61). PAB wide (Fig. 61). *Measurements:* Total length 6.40. Carapace 2.45 long, 2.30 wide. Clypeus 0.95 long. Diameter AME 0.14, ALE 0.22, PME 0.17, PLE 0.20. Distance ALE-PME 0.17, PME-PME 0.26. Leg I: 45.31 (11.75 + 1.07 + 11.87 + 15.62 + 5.00), tibia II: 8.40, tibia III: 6.25, tibia IV: 8.30. Tibia I l/d: 31.50.

Female (Paratype). Similar to the male, differences: *Prosoma:* The three brown spots bigger and darker than on male. Clypeus with brown region longer than on male, forming an upside down, U-shaped area. *Legs:* The brown rings on femora and tibiae slightly more marked than on male. *Epigynum:* Wider than long, with three projections at apex (Fig 64, 66, 67), with a small rounded pit on central projection (Fig. 64). PP small (Fig. 65); with small, oval sac-shaped concavities between MSE and PP (Fig. 65). MSE with upside down Y-shape (Fig. 65). *Measurements:* Total length 5.40. Carapace 2.15 long, 2.10 wide. Clypeus 0.80 long. Diameter AME 0.10, ALE 0.22, PME 0.18, PLE 0.21. Distance ALE-PME 0.16. PME-PME 0.24. Leg I: 31.97 (8.70+1.00+8.90+10.37+3.00), tibia II: 6.40, tibia III: missing, tibia IV: 6.50; tibia I l/d 28.40.

Natural History. The specimens were collected in an oak forest: the females were collected in their irregular sheet webs among boulders on the ground; the male holotype was collected in an irregular sheet web in a corner inside a cabin, being the first specimen of the genus *Ixchela* collected inside a human building.

Distribution. MEXICO: Puebla (Fig. 90).



Figures 56—67. *Ixchela mendozai* new species. Male: 56-57, Habitus, lateral and dorsal views respectively. 58, Carapace, frontal view. 59, Chelicerae, frontal view. 60-61, Left palp, retrolateral and prolateral views respectively. 62, Chelicera, lateral view. 63, Bulb and embolus, prolatero-dorsal view (arrow indicates the curved and sharp sub-distally sclerotized spine). Female: 64, Epigynum, ventral view. 65, Epigynum, dorsal view. 66, Epigynum, left lateral view. 67, Epigynum, frontal view. Scales: 0.5 mm (Figs 58, 59, 62-67), 1 mm (Figs 56, 57, 60, 61).

IXCHELA PUREPECHA new species

Figs 68-78

Type data. MEXICO: Michoacán: 1 ♂ holotype (CNAN T0791) [28 August 2010; A. Valdez, O. Francke, C. Santibáñez] from 8.5 km W of Huiramangaro, Km 30 federal road 14 (lat 19.5065°, -101.8334°; 2215 m), Municipio Santiago Tingambato. Paratypes: 1 ♀ (CNAN T0792); 2 ♂♂, 2 ♀♀ (CNAN T0793), same data as holotype.

Material examined. MEXICO: Michoacán: 1 ♀, 1 immature (CNAN) [24 March 2000; F. Alvarez, E. González, O. Delgado, J. Castelo, E. Lira, O. Francke, C. Duran] from Road Uruapan-Los Reyes Salgado (lat 19.5272°, -102.1921°; 2300 m). 6 ♂♂, 6 ♀♀, 6 immatures (CNAN), same data as holotype. 4 ♀♀ (CNAN) [30 April 2011; A. Valdez, O. Francke, J. Cruz, R. Monjaraz, E. Miranda] from Parque Nacional Barranca de Cupatitzio (lat 19.4280°, -102.0936°; 1760 m), Municipio Uruapan. 2 ♀♀, 1 immature (UMSNH) [26 June 1988; L. García]; 1 ♂, 1 immature (UMSNH) [11 December 1988; L. García]; 1 ♀ (with egg sac), 2 ♀♀, 4 immatures (UMSNH) [19 August 1988; L. García]; 3 immatures (UMSNH) [27 November 1988; L. García]; 1 ♀, 2 immatures (UMSNH) [16 July 1988; L. García]; 1 ♀, 2 immatures (UMSNH) [23 August 1988; L. García]; 2 ♀♀, 1 immature (UMSNH) [30 July 1988; L. García]; 1 ♀, 1 immature (UMSNH) [24 September 1988; L. García]; same locality. 1 ♂, 1 ♀, 1 immature (CNAN) [30 April 2011; A. Valdez, O. Francke, J. Cruz, R. Monjaraz, E. Miranda] from Angahuan Paricutín, Road to Ruínas del Viejo San Juan Parangaricutiro (lat 19.5425°, -102.2342°; 2392 m).

Etymology. The specific name is a noun in apposition and refers to the ethnic group: Los Purépechas; that live principally in the state of Michoacán, Mexico, where the type locality is located.

Diagnosis. Resembles *I. azteca*, distinguished by the FAC wider, more rounded distally (Figs 71, 74); by the shape of the femur of palp almost straight (Figs 72, 73), whereas that in *I. azteca* is ventrally curved and considerably wider distally than basally (Figs 38, 39); by the VAF wider basally and ending in a longer tip (Fig. 72); and by the epigynum longer and thinner, ending in a large median projection (Figs 75, 78); in frontal view, the lateral angles on the epigynum are bigger and visible (Fig. 78).

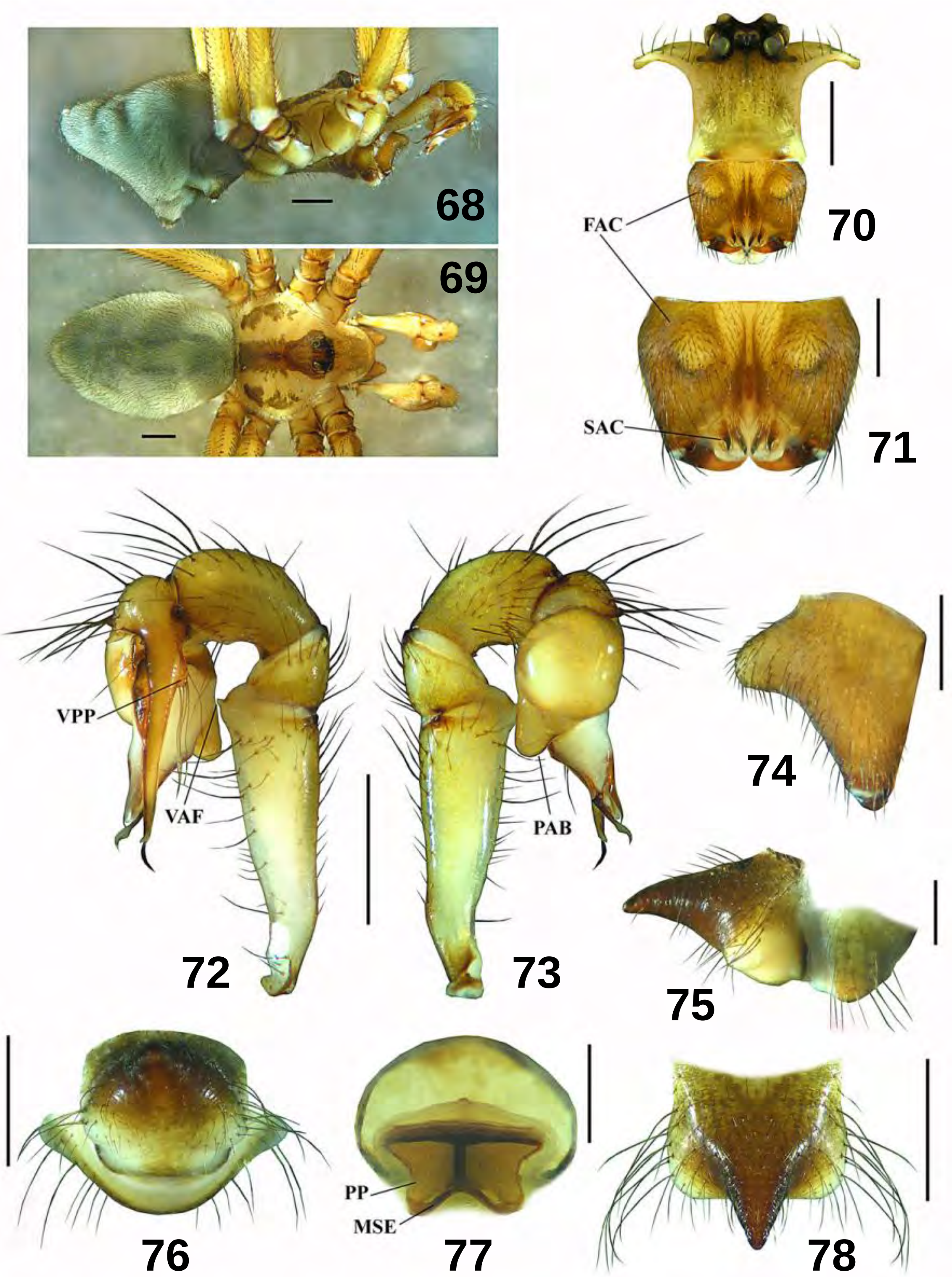
Description. Male (Holotype). Prosoma: Pale yellow, with a wide, pale brown pattern on each side (Fig. 69). Ocular region brown, with inconspicuous brown lines projecting from AME and PME backwards (Fig. 69). Fovea surrounded with wide brown region (Fig. 69). Clypeus pale yellow, with inconspicuous gray region distally (Fig. 70). Chelicerae brown, paler around the SAC and basally (Fig. 71). Sternum olive. Labium and endites brown, white distally. *Legs:* Coxae pale yellow, pale brown distally on retro and prolateral part. Trochanters brown. Femora, patellae, tibiae, metatarsi, and tarsi brown. Femora and with a wide, brown ring sub-distally. Tibiae with a dark ring basally and another one distally. *Opisthosoma:* Conical, pale blue, longer than high (Figs 68, 69). Gonopore plate olive, oval. *Palp:* Femur pale yellow, with several long setae ventrally (Figs 72, 73). VAF wide basally, ends in small tip (Fig. 72). Patella and tibia orange. Procursus dark orange, paler basally, long and slightly sigmoid; distal spine thin and curved (Fig. 72). VPP with 5-6 long setae (Fig. 72). Embolus conical, dorsally with a small and thin spine (Figs 72, 73), ventrally with apical sigmoid projection (Figs 72, 73). PAB wide (Fig. 73). *Measurements:* Total length 9.2. Carapace 3.90 long, 3.50 wide. Clypeus 1.45 long. Diameter AME 0.16, ALE 0.30, PME 0.22, PLE 0.25. Distance ALE-PME 0.19, PME-PME 0.38. Leg I: 61.71 (16.87 + 1.60 + 16.12 + 20.37 + 6.75), tibia II: 11.87, tibia III: 9.75, tibia IV: 12.31. Tibia I l/d: 25.70.

Female (Paratype). (CNAN T0792). Similar to the male, differences: *Prosoma:* Dorsal pattern on carapace darker brown than on male. Ocular region and around the fovea darker brown than on male. Clypeus with a wide, pale brown longitudinal region. Chelicerae dark brown. Sternum pale brown. *Legs:* Femora and patellae brown; tibiae, metatarsi and tarsi orange. *Epigynum:* Higher than long and wide, with a long conical protuberance distally (Figs 75, 76, 78). PP wide, laterally curved (Fig. 77), with small oval, sac-shaped concavities between MSE and PP, only visible in anterior-dorsal view (Fig. 77). MSE with upside-down Y-shape (Fig. 77). *Measurements:* Total length 9.90. Carapace 3.40 long, 3.00 wide. Clypeus 1.32 long. Diameter AME 0.14, ALE 0.24, PME 0.20, PLE 0.23. Distance ALE-PME 0.18. PME-PME 0.32. Leg I: 46.72 (12.25+1.40+12.87+15.00+5.20), tibia II: 9.35, tibia III: 7.25, tibia IV: 9.45; tibia I l/d 25.50.

Variation. There is continuous variation in the size and coloration in males and females from different localities, even within specimens from the same locality. The specimens from 8.5 km W of Huiramangaro, Km 30 federal road 14 have pale brown, brown, or dark brown coloration. This was the same pattern found in the specimens from Parque Nacional Barranca de Cupatitzio. In both localities, there were specimens notably smaller than the others, even with variation in the opisthosomal coloration: gray, pale gray, blue, or pale blue. *Males:* 8.5 km W of Huiramangaro, Km 30 federal road 14 (N= 6), tibia I: 11.75-14.75 (x= 14.38). Parque Nacional Barranca de Cupatitzio (N= 2), tibia I: 9.40, 9.80. *Females:* 8.5 km W of Huiramangaro, Km 30 federal road 14 (N= 5), tibia I: 11.00-14.12 (x= 13.39). Parque Nacional Barranca de Cupatitzio (N= 4), tibia I: 11.25-15.00 (x= 12.70).

Natural History. The specimens from the type locality were collected in a pine-oak forest on their sheet webs on walls along road-cuts, with high humidity and covered with roots and leaf-litter. Some of the paratypes were collected among fallen logs and boulders on the ground. The specimens from Parque Nacional Barranca de Cupatitzio were collected on their sheet webs on walls along road-cuts and on crevices on the karstic ground of the zone; others were collected among fallen logs and boulders on the ground. Some of these specimens were collected more easily at night using head lamps, because the spiders were easily visible on their sheet webs on walls along road-cuts; in comparison with daytime when only the apparently empty sheet webs are visible. The specimens from Angahuan Paricutín, Road to Ruínas del Viejo San Juan Parangaricutiro were collected under fallen logs, and among dry roots of an agave plant; microhabitat with high humidity.

Distribution. MEXICO: Michoacán (Fig. 90).



Figures 68—78. *Ixchela purepecha* new species. Male: 68-69, Habitus, lateral and dorsal views respectively. 70, Carapace, frontal view. 71, Chelicerae, frontal view. 72-73, Left palp, retrolateral and prolateral views respectively. 74, Chelicera, lateral view. Female: 75, Epigynum, left lateral view. 76, Epigynum, ventral view. 77, Epigynum, anterior-dorsal view. 78, Epigynum, frontal view. Scales: 0.5 mm (Figs 71, 74, 75, 77), 1 mm (Figs 68-69, 72, 73, 76, 78).

IXCHELA TLAYUDA new species

Figs 79-89

Type data. MEXICO: Oaxaca: 1 ♂ holotype (CNAN T0787) [4 November 2012; C. Santibáñez] from San Pablo Etla, forest La Nevería (lat 17.1668°, lon -96.6851°; 2981 m), Distrito Etla, Municipio San Pablo Etla. Paratypes: 1 ♀ (CNAN T0788), 2 ♀♀ (CNAN T0789), same data as holotype.

Material examined. MEXICO: Oaxaca: 2 ♀♀, 5 immatures (CNAN) [19 September 2009; A. Valdez, C. Santibáñez, R. Paredes, J. Cruz] from San Felipe del Agua (lat 17.1162°, lon -96.7095°; 2001 m), Municipio San Felipe del Agua. 1 ♂ (CNAN) [19 February 2005; G. Gutierrez], same locality. 1 ♀ (CNAN) [12 November 2005; O. Francke, G. Montiel, C. Santibáñez], same locality. 1 ♀ (CNAN) [18 June 2007; A. Valdez, C. Santibáñez] from Campamento del Monte, El Punto (lat 17.2011°, lon -96.5879°; 2500 m), Municipio Sta. Catarina Ixtepeji, Distrito Ixtlán. 1 ♂, 2 ♀♀ (CNAN) [27 November 2010; G. Montiel, M. Hernández, R. Paredes] from Parador Ecoturistico del Monte, 3 km S of El Punto (lat 17.2017°, lon -96.5911°; 2537 m), Municipio Sta. Catarina Ixtepeji. 2 ♂♂, 2 ♀♀ (with egg sac) (CNAN) [26 March 2010; A. Valdez, O. Francke, C. Santibáñez, J. Cruz] from 9 km N of San Miguel Etla, road to Las Guacamayas (lat 17.2247°, lon -96.7385°; 2197 m), Municipio San Miguel Etla, Distrito San Miguel Etla. 3 ♀♀ (2 with egg sac), 2 immatures (CNAN) [23 April 2010; A. Valdez, C. Santibáñez, J. Cruz, D. Barrales] from Km 189 road Tuxtepec-Oaxaca (lat 17.1934°, lon -96.6001°; 2561 m). 3 ♂♂, 4 ♀♀ (one with egg sac), 1 immature CNAN) [22 April 2010; A. Valdez, C. Santibáñez, J. Cruz, D. Barrales] from Campamento Las Flores (lat 17.3509°, lon -96.5312°; 2320 m), Municipio Santa María Jaltianguis, Distrito Ixtlán. 1 ♂, 1 ♀, 2 immatures (CNAN) [18 September 2009; A. Valdez, C. Santibáñez, R. Paredes] from Centro Recreativo Calpulalpan de Méndez (lat 17.3228°, lon -96.4452°; 2000 m), Distrito Ixtlán. 2 ♀♀ (CNAN) [22 April 2010; A. Valdez, C. Santibáñez, J. Cruz, D. Barrales], same locality. 1 ♂, 3 ♀♀, 2 immatures (CNAN) [18 September 2009; A. Valdez, C. Santibáñez, R. Paredes] from La Trinidad (lat 17.2865°, lon -96.4379°; 2268 m), Distrito Ixtlán de Juárez. 1 ♂ (CNAN) [3 April 2005; Col.?] from Tierra Colorada, Distrito Ixtlán de Juárez. 1 ♀ (CNAN) [22 July 2007; A. Valdez, O. Francke, H. Montaño, C. Santibáñez, A. Ballesteros] from Campamento Tatachinto (lat 17.2876°, lon -96.4176°; 2326 m), Municipio Santiago Xiacuí, Distito Ixtlán de Juárez. 1 ♀ (CNAN) [3 November 2005; A. Valdez, O. Francke, H. Montaño] from road to Magdalena Mixtepec (lat 16.9301°, lon -96.8742°; 2676 m). 1 ♂ (CNAN) [16 March 2008; A. Valdez, C. Satibáñez, H. Montaño] from La Trinidad, Santiago Xiacuí (lat 17.2865°, lon -96.4377°; 2258 m). 5 ♀♀, 1 immature (CNAN) [11 September 2010; A. Valdez, O. Francke, J. Cruz, D. Barrales] from 1 km W of Puerto de la Soledad (lat 18.1754°, lon -97.0050°; 2245 m), Municipio Huautla de Jiménez. 1 ♀, 2 immatures (CNAN) [15 March 2008; A. Valdez, H. Montaño, C. Santibáñez] from Tlahuitoltepec (lat 17.0927°, lon -96.0547°; 2040 m), Municipio Santa María Tlahuitoltepec, Distrito Mixes. 1 ♂ (CNAN) [14 September 2009; A. Valdez, C. Santibáñez, R. Paredes], same locality. 1 ♀ (CNAN) [14 September 2009; A. Valdez, C. Santibáñez, R. Paredes] from Puente Azul (lat 17.0026°, lon -96.1193°; 1862 m), Municipio Ayutla.

Etymology. The specific name is a noun in apposition and refers to the name of the most famous traditional food in the central region of the state of Oaxaca: Las Tlayudas; and because the type locality is located in that region.

Diagnosis. Resembles *I. abernathyi* and *I. mendozai*, distinguished from *I. abernathyi* by FAC wider and longer, ending in a small tip (Fig. 85); by the pattern around the fovea wider (Fig. 80); by the VAF larger (Fig. 83); by the central apex of the epigynum larger and curved (Fig. 86); by the lateral apex of the epigynum more rounded and bigger (Figs 87, 89); and by the opisthosoma more conical (Fig. 79); from *I. mendozai* by the FAC ending in a small tip (Figs 82, 85), whereas on *I. mendozai* are wider and rounded distally (Fig. 62); by the median distal protuberance of the epigynum shorter (Figs 86, 89), which is not as wide and curved as on *I mendozai* (Figs 66, 67); and by the MSE which does not touch the PP (Fig. 88), whereas in *I. mendozai* the MSE touches the PP (Fig. 65).

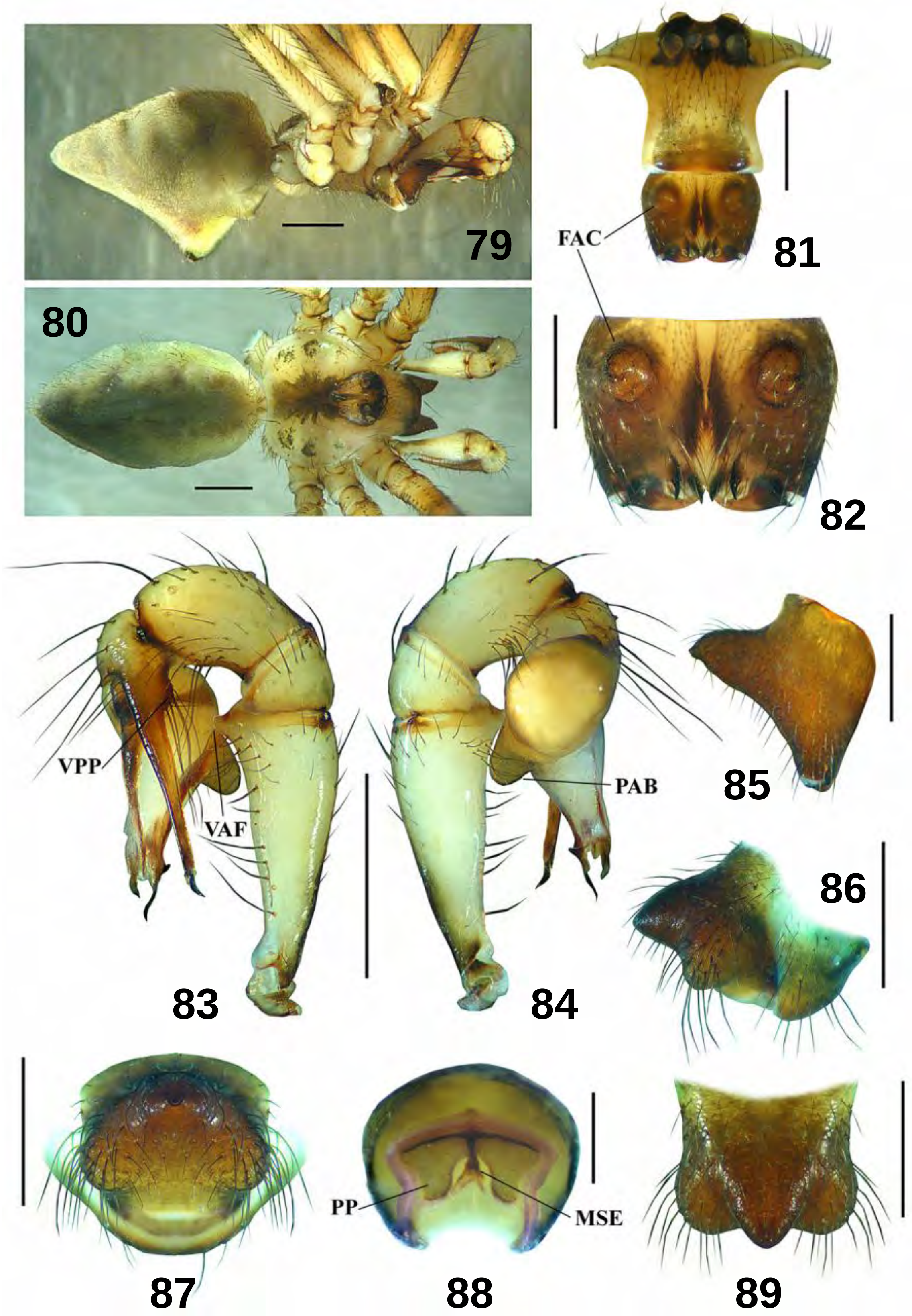
Description. Male (Holotype). Prosoma: Beige, with three small and brown spots on each side (Fig. 80). Ocular region brown, with a gray longitudinal line projecting from AME (Fig. 80). Fovea surrounded with wide, gray, and irregular region, extending backward (Fig. 80). Clypeus beige, with a distal, dark gray region (Fig. 81). Chelicerae brown, pale on basal part and around the SAC (Fig. 82). Sternum pale yellow. Labium and endites dark gray; endites with retrolateral apophysis weak, with a small, subdistal protuberance. *Legs:* Coxae pale yellow, distally with gray region on prolateral and retrolateral parts. Trochanters pale brown. Femora pale orange; femora I-III brown basally, with several pale gray rings throughout their length; one dark gray sub-distal ring, wide, very marked. Patellae gray. Tibiae pale orange, with several gray rings throughout their length, less visible than on femora. Metatarsi and tarsi orange, without color rings. Legs with numerous oblique, long setae; with few short, vertical setae. *Opisthosoma:* Conical, longer than high, pale gray (Figs 79, 80). Gonopore plate oval, pale olive. *Palp:* Femur pale yellow, basally gray on dorsal part, with several long setae ventrally, with VAF conical (Fig. 83). Patellae and tibia pale orange, basally gray on dorsal part. Procursus brown, basally pale orange on dorsal part, with distal, curved spine (Fig. 83). VPP with 3-5 long setae (Fig. 83). Embolus conical, dorsally with small curved spine (Figs 83, 84), ventrally with long curved sigmoid projection (Figs 83, 84). PAB wide (Fig. 84). *Measurements:* Total length 6.90. Carapace 2.70 long, 2.40 wide. Clypeus 1.15 long. Diameter AME 0.16, ALE 0.25, PME 0.18, PLE 0.20. Distance ALE-PME 0.16, PME-PME 0.28. Leg I: 45.55 (12.12 + 1.06 + 12.00 + 15.75 + 4.62), tibia II: 8.80, tibia III: 6.90, tibia IV: missing. Tibia I l/d: 28.00.

Female (Paratype). (CNAN T0788). Similar to the male, differences: *Prosoma:* Carapace with the three spots darker and bigger than on male. Fovea surrounded with irregular brown area. Clypeus with brown region U-shaped. Chelicerae darker brown than on the male. Sternum yellow, with lateral dark gray spots. Labium and endites brown. *Legs:* Femora, patellae, tibiae, metatarsi, and tarsi darker than the male. Legs with rings throughout their length, more noticeable than on the male. *Opisthosoma:* Pale blue. *Epigynum:* Wider than long, with three rounded projections distally (Figs 86, 87, 89); small rounded pit on central projection (Fig. 87). PP wide; with small oval, sac-shaped concavities between MSE and PP (Fig. 88). The MSE does not touch the PP (Fig. 88). *Measurements:* Total length 9.40. Carapace 3.40 long, 2.90 wide. Clypeus 1.30 long. Diameter AME 0.12, ALE 0.28, PME 0.20, PLE 0.20. Distance ALE-PME 0.18. PME-PME 0.28. Leg I: 46.85 (12.00+1.30+12.81+15.37+5.37), tibia II: 9.10, tibia III: 7.10, tibia IV: 9.20; tibia I l/d 29.28.

Variation. There is continuous variation in color and size of the specimens, even among specimens of the same sex and from the same population. The carapace pattern is brown, dark brown, gray or dark gray, even is some specimens this pattern is more marked than others. The legs are brown, pale yellow, dark orange or dark brown; some specimens have color rings on femur and tibiae more marked than others. Some specimens have opisthosoma pale blue, gray or pale yellow. *Males:* Parador Ecoturístico del Monte, 3 km S of El Punto (N= 1): tibia I: 11.37. Centro Recreativo Calpulalpan de Méndez (N= 1): tibia I: 13.75. Campamento las Flores (N= 3): tibia I: 10.50-11.87 (*x*= 10.99). La Trinidad (N= 1): tibia I: 13.25. San Felipe del Agua (N= 1): tibia I: 14.56. *Females:* Parador Ecoturístico del Monte, 3 km S of El Punto (N= 2): tibia I: 11.35, 11.37. La Trinidad (N= 2): tibia I: 10.10, 11.12. 1 km W of Puerto de la Soledad (N= 5): tibia I: 9.18-10.75 (*x*= 10.39). Campamento las Flores (N= 4): tibia I: 8.37-11.12 (*x*= 9.34). San Felipe del Agua (N= 2): tibia I: 12.37, 13.43.

Natural History. The specimens from different localities were collected on their sheet webs in oak, pine or oak-pine forest. The specimens from San Felipe del Agua were collected along road-cuts in wet and shaded areas near a river. The specimens from Campamento del Monte, El Punto and from 9 km N of San Miguel Etla, road to Las Guacamayas; were collected under big fallen logs and boulders on the ground. Some specimens from Campamento Las Flores were collected under and among fallen logs; others were collected inside hollows at the bases of pine trees. Some specimens from Centro Recreativo Calpulalpan de Méndez were collected on holes in a big karstic wall next to a river, others among fallen logs and boulders on the ground near the river, this place had a high humidity, ca 80%. The specimens from La Trinidad were collected among numerous boulders on the ground. The specimens from Tlahuitoltepec were collected under fallen logs in a disturbed pine forest; it should be noted that those specimens were collected outside the Cueva de Tlahuitoltepec, which is the type locality of *Ixchela mixe* Valdez-Mondragón, 2013, so they could be sympatric species.

Distribution. MEXICO: Oaxaca (Fig. 90).



Figures 79—89. *Ixchela tlayuda* new species. Male: 79-80, Habitus, lateral and dorsal views respectively. 81, Carapace, frontal view. 82, Chelicerae, frontal view. 83-84, Left palp, retrolateral and prolateral views respectively. 85, Chelicera, lateral view. Female: 86, Epigynum, left lateral view. 87, Epigynum, ventral view. 88, Epigynum, dorsal view. 89, Epigynum, frontal view. Scales: 0.5 mm (Figs 82, 85, 88), 1 mm (Figs 79-81, 83, 84, 86, 87, 89).

Figure 90. Known distribution of *Ixchela azteca* new species, *Ixchela jalisco* new species, *Ixchela mendozai* new species, *Ixchela purepecha* new species, and *Ixchela tlayuda* new species.

PHYLOGENETIC RELATIONSHIPS (MORPHOLOGY)

The morphological characters used in the phylogenetic analysis (40 characters [34 binary and six multistate]) were as follows:

Palp

1. Palp of male, bulb prolateroventral apophysis (PAB) (Fig. 1): (0) absent, (1) present.
2. Palp of male, femur shape: (0) wide (*Physocyclus, Priscula*), (1) slender basally, markedly wide in the distal third part (‘*Coryssocnemis*’), (2) long and slender, with cone-shape (Figs 38, 49).
3. Embolus, ventral sclerotized line, from bulb to apical part: (0) absent, (1) present.
4. Femur, ventrodistal apophysis (VAF) on palp of male (Figs 60, 72): (0) absent, (1) present.
5. Femur, ventrodistal protuberance on palp of male (*Ixchela taxco*) (Valdez-Mondragón, 2013; fig. 140): (0) absent, (1) present.
6. Embolus, basal protuberance, ending in round tip, near to PAB: (0) absent, (1) present.
7. Embolus, apical ventral projection (Figs 8, 10, 44): (0) absent, (1) present.
8. Embolus, apical dorsal projection, with spine-shape (Figs 2, 39, 50): (0) absent, (1) present.
9. Embolus, ratio: (0) length of embolus < diameter of bulb, (1) length of embolus > diameter of bulb.
10. Embolus, dorsal thin sclerotized line: (0) absent, (1) present.

11. Embolus, long and wide sclerotized dorsal-retrolateral line (Figs 38, 49): (0) absent, (1) present.
12. Procursus, "brush" of pseudotrichia distally: (0) absent, (1) present.
13. Procursus, ventral pocket and dorsal apophysis on procursus: (0) absent, (1) present.
14. Tarsus, dorsal apophysis 1b, basally: (0) absent, (1) present in dorsal part, (2) present in retrolateral part.
15. Tarsus, dorsal apophysis 1d, basally: (0) absent, (1) present in dorsal part, (2) present in retrolateral part.
16. Procursus, serrated tip or with small projections, poorly sclerotized (*Aymaria*): (0) absent, (1) present.
17. Procursus, sclerotized spine distally, small and curved (Figs 38, 49): (0) absent, (1) present.
18. Procursus, long setae: (0) absent, (1) present on ventral-basal part, (2) present on ventral protuberance (VPP) (Figs 15, 38, 60).
19. Procursus, setae on basal-dorsal part: (0) absent, (1) present.
20. Procursus, setae on basal-dorsal part, number: (0) two setae (Fig. 14), (1) three setae (Fig. 16).
21. Procursus, shape: (0) short with long spine distally, (1) thin and wide distally (*Priscula*), (2) conical and long, wide basally (*Ixchela*) (Figs 49, 50, 72), (3) conical, markedly wide basally (*'Coryssocnemis'*, *Aymaria*, Huber, 2000; fig. 583).
22. Embolus, ventrally with a small sub-distally sclerotized spine (arrow, Fig. 9): (0) absent, (1) present (1).

Chelicerae

23. Chelicerae of male, frontal apophysis of chelicerae (FAC) (Figs 26, 36, 37): (0) absent, (1) present.
24. Chelicerae of male, shape of FAC: (0) short and wide, located on median part of chelicerae, (1) wide and rounded (Valdez-Mondragón, 2013; figs 74, 100, 189), (2) conical and small (Valdez-Mondragón, 2013; figs 21, 22, 62, 63), (3) conical, long and wide (Valdez-Mondragón, 2013; figs 162, 163), (4) conical and very small, located near to retrolateral part (Valdez-Mondragón, 2013; figs 149, 204), (5) long and slightly curved, located near to prolateral part (Valdez-Mondragón, 2013; fig. 112), (6) long and curved, located basally on median part of each chelicerae (Valdez-Mondragón, 2013; figs 136, 137), (7) small and rounded, located on central part of chelicerae (Valdez-Mondragón, 2013; figs 124, 125), (8) long and conical, slightly projected toward up and slightly curved apically (Fig. 51).
25. Chelicerae of male, distal-frontal apophysis, next to the fangs (*Aymaria*): (0) absent, (1) present.
26. Chelicerae of female, lateral stridulatory files: (0) absent, (1) present.
27. Chelicerae of male, frontal-distal sclerotized apophyses (SAC): (0) absent, (1) present, reminiscent (Valdez-Mondragón, 2013; fig. 74), (2) present, highly visible (Figs 26, 27, 37).
28. Chelicerae of male, frontal and curved sclerotized apophyses (Valdez-Mondragón, 2013; figs 49, 88): (0) absent, (1) present.

Prosoma

29. Male palpal coxa with retrolateral apophysis: (0) absent, (1) present.
30. Carapace, dorsal pattern around the fovea: (0) complete, touching the ocular region (Fig. 35), (1) incomplete, leaving a small region without touching the ocular region (Valdez-Mondragón, 2013; fig. 99).

Legs

31. Tibiae and metatarsi with curved setae: (0) absent, (1) present.
32. Femora and tibiae with numerous rings: (0) absent, (1) present.

Opisthosoma

33. Epigynum, ratio: (0) wider that long (Figs 64, 76), (1) longer than wide (Valdez-Mondragón, 2013; figs 95, 183).
34. Epigynum, median septum (MSE) in dorsal view (Figs 43, 54): (0) absent, (1) present.
35. Concavities with sac-shape between MSE and pore plates (Figs 54, 65): (0) absent, (1) present.
36. Epigynum, small and circular concavity in frontal distal part (Fig. 64): (0) absent, (1) present.
37. Epigynum, lateral constraints in anterior part (Valdez-Mondragón, 2013; figs 41, 95, 183): (0) absent, (1) present.
38. Epigynum, lateral rounded protuberances each side, near to the epigastric furrow (Figs 53, 64): (0) absent, (1) present.
39. Epigynum, lateral rounded protuberances each side, size: (0) inconspicuous (Fig. 55), (1) wide and conspicuous (Fig. 67).
40. Epigynum, lateral rounded protuberances each side, position: (0) next to the epigastric furrow (Fig. 41), (1) leaving a space between the protuberances and the epigastric furrow (Fig. 66).

The heuristic equal weighting searches in NONA found five most parsimonious cladograms, and the strict consensus tree (L=59, CI= 0.72, RI= 0.84) collapsed five nodes (Fig. 91). The monophyly of *Ixchela* was supported by high Jackknife and Bremer values (Fig. 91), and eight synapomorphies (chars. 1, 2, 7, 8, 17, 18, 21, 22) (Fig. 91; see discussion for character states). The analyses with implied weighting (Table 3), using seven different concavity values (*K*) also support the monophyly of *Ixchela* with Jackknife values of 100%.

All analyses with implied weighting found the same five most parsimonious trees and the same phylogenetic relationships within *Ixchela* as were obtained in the analysis with equal weighting (Fig. 91). Analyses with concavity values (*K*= 5, 9, and 10) obtained the same length (59 steps) and the same topologies as the analysis with equal weighting. These same analyses also found the highest CI and RI values (0.72 and 0.84 respectively) (Table 3).

Table 3. Summary of the cladograms statistics with morphological data among the most parsimonious trees (MPT) found with equal weighting (EW) and implied weighting (IW); using seven concavity values (*K*), arranged in order of increasing fit values (*fi*). CI= Consistency index. RI= Retention index.

Analyses	MPT	Steps	fit (*fi*)	CI	RI	Jackknife support for *Ixchela*
IW: *K*= 1	5	60	25.08	0.71	0.83	J= 100
IW: *K*= 2	5	60	26.70	0.71	0.83	J= 100
EW	5	59	27.55	0.72	0.84	J= 100
IW: *K*= 3	5	60	27.60	0.71	0.83	J= 100
IW: *K*= 4	5	60	28.18	0.71	0.83	J= 100
IW: *K*= 5	5	59	28.60	0.72	0.84	J= 100
IW: *K*= 9	5	59	29.50	0.72	0.84	J= 100
IW: *K*= 10	5	59	29.63	0.72	0.84	J= 100

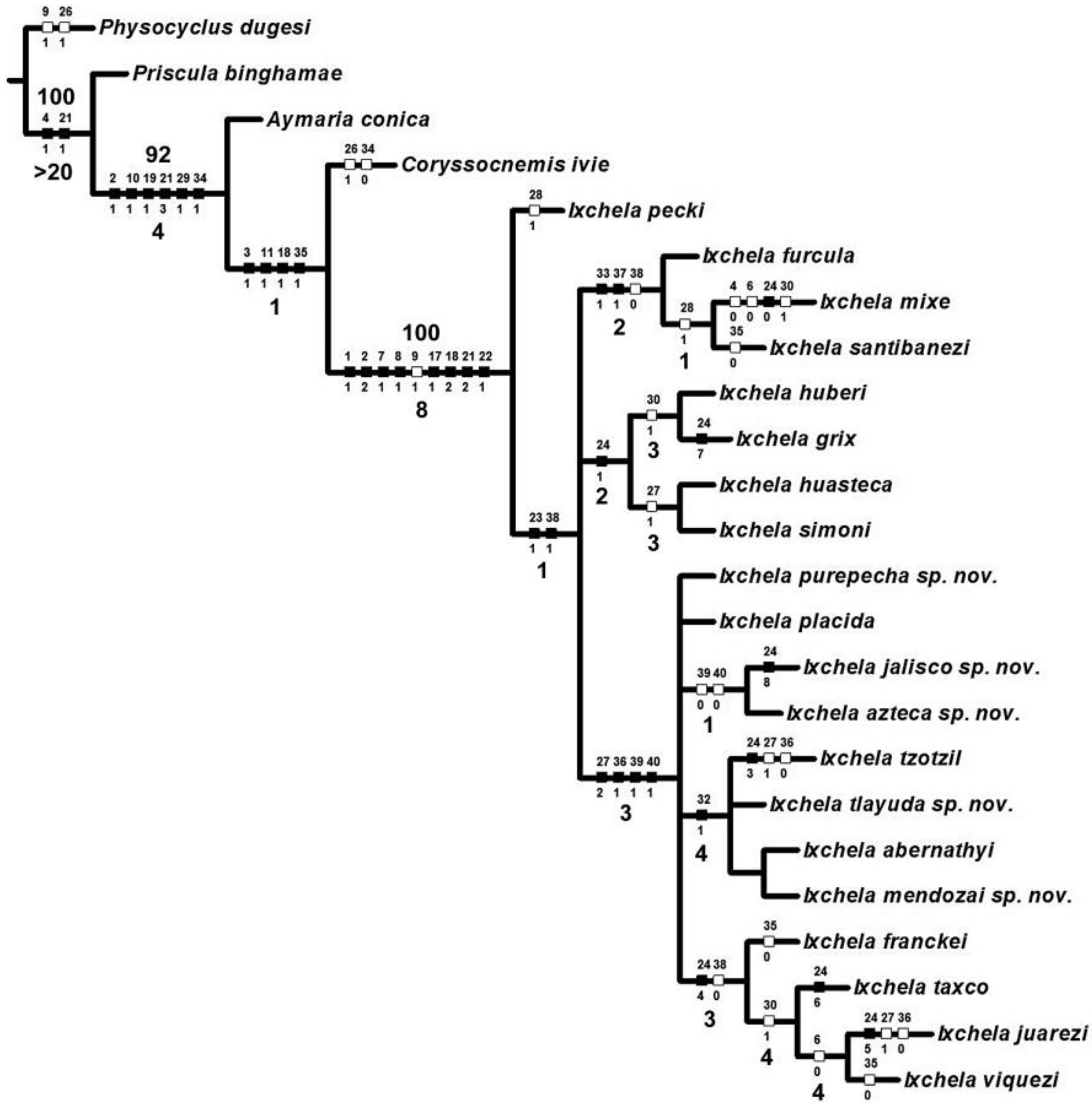


Figure 91. Consensus tree of five most parsimonious trees obtained by the morphological cladistic analysis with equal weighting of characters (L=59, CI= 0.72, RI= 0.84). Black squares bars indicate synapomorphic or apomorphic states, whereas white squares indicate homoplastic characters states. Small numbers above squares indicate character number; small numbers below squares indicate character state. Larger numbers above branches indicate Jackknife support values; larger numbers below branches indicate Bremer support values.

PHYLOGENETIC RELATIONSHIPS (MOLECULAR DATA)

Cytochrome c oxidase subunit I (CO1) gene.

The character matrix of CO1 comprised 506 characters, of which 178 were potentially informative and 328 were uninformative and deactivated for the analysis with PA. PA analysis using equal weighting under NONA resulted in two equally most parsimonious trees (L=1031, CI= 0.39, RI= 0.32). The strict consensus tree is not shown because the same clades were recovered with BI (Fig. 92). The Bremer support value with PA using equal weighting under TNT support the monophyly of *Ixchela* with Bremer value= 10, whereas the Jackknife values was not significant to support the monophyly of the genus

(Fig. 92). Moreover, the BI analysis strongly supports the monophyly of the genus with a posterior probability value of 94% (Fig. 92).

Due to the molecular matrix had high amounts of homoplastic characters, which were observed when the characters were mapped on the PA tree, the implied character weighting was conducted to analyze the effects of weighting against homoplasy under PA. The analyses with PA using implied weighting with seven different concavity values (*K*) found higher Jackknife values than equal weighting analysis that support *Ixchela* as monophyletic (Table 4).

The analyses with implied weighting found only one most parsimonious tree, although the analysis with *K*=2 found the same two most parsimonious trees as the analysis with equal weighting (Table 4). The analyses with equal weighting and implied weighting (*K*= 5, 9, 10) found the highest CI and RI values (Table 4). The different topologies found under implied weighting support the monophyly of *Ixchela* recovering higher Jackknife values than equal weighting analysis, which had a low value (Table 4).

The analysis with CO1 found two clades within the genus *Ixchela* (arrows, Fig. 92), being *Ixchela furcula* the sister species of the rest of the genus. The upper clade was a polytomy composed only for five species, supported by an 89% of posterior probability (upper arrow, Fig. 92). The close relationships between *Ixchela franckei* + *Ixchela viquezi* was strongly supported by Jackknife and Bremer values, and by posterior probabilities; besides it was recovered under PA and five concavity values of implied weightings (Fig. 92). The lower clade was composed for 14 species, with *Ixchela grix* and *Ixchela tzotzil* as sister species of the rest of the clade (lower arrow, Fig. 92). This clade is composed for a polytomy, being the clades A, B, C, and D (Fig. 92) which are composed for sister species, the clades with better Jackknife and Bremer values and by posterior probabilities, besides recovering by PA under several concavity values (Fig. 92).

Table 4. Summary of the phylogenetic hypothesis with CO1 and 16S genes among the most parsimonious trees (MPT) found with equal weighting (EW) and implied weighting (IW); using seven concavity values (*K*), arranged in order of increasing fit values (*fi*). CI= Consistency index. RI= Retention index.

Analyses	**MPT CO1/16S**	**Steps CO1/16S**	**fit (*fi*) CO1/16S**	**CI CO1/16S**	**RI CO1/16S**	**Jackknife support for *Ixchela* CO1/16S**
IW: *K*= 1	1/2	1068/589	56.52/54.33	0.38/0.51	0.28/0.36	J= 88/43
IW: *K*= 2	2/1	1055/579	78.99/68.94	0.38/0.52	0.30/0.39	J= 99/54
EW	2/4	1031/568	92.31/77.26	0.39/0.53	0.32/0.41	J= 57/54
IW: *K*= 3	1/1	1049/575	93.74/77.88	0.38/0.52	0.30/0.40	J= 100/55
IW: *K*= 4	1/1	1049/575	104.35/83.99	0.38/0.52	0.30/0.40	J= 100/58
IW: *K*= 5	1/1	1034/569	112.56/88.49	0.39/0.53	0.32/0.41	J= 99/56
IW: *K*= 9	1/1	1034/569	132.41/98.86	0.39/0.53	0.32/0.41	J= 97/54
IW: *K*= 10	1/1	1033/569	135.57/100.44	0.39/0.53	0.32/0.41	J= 96/52

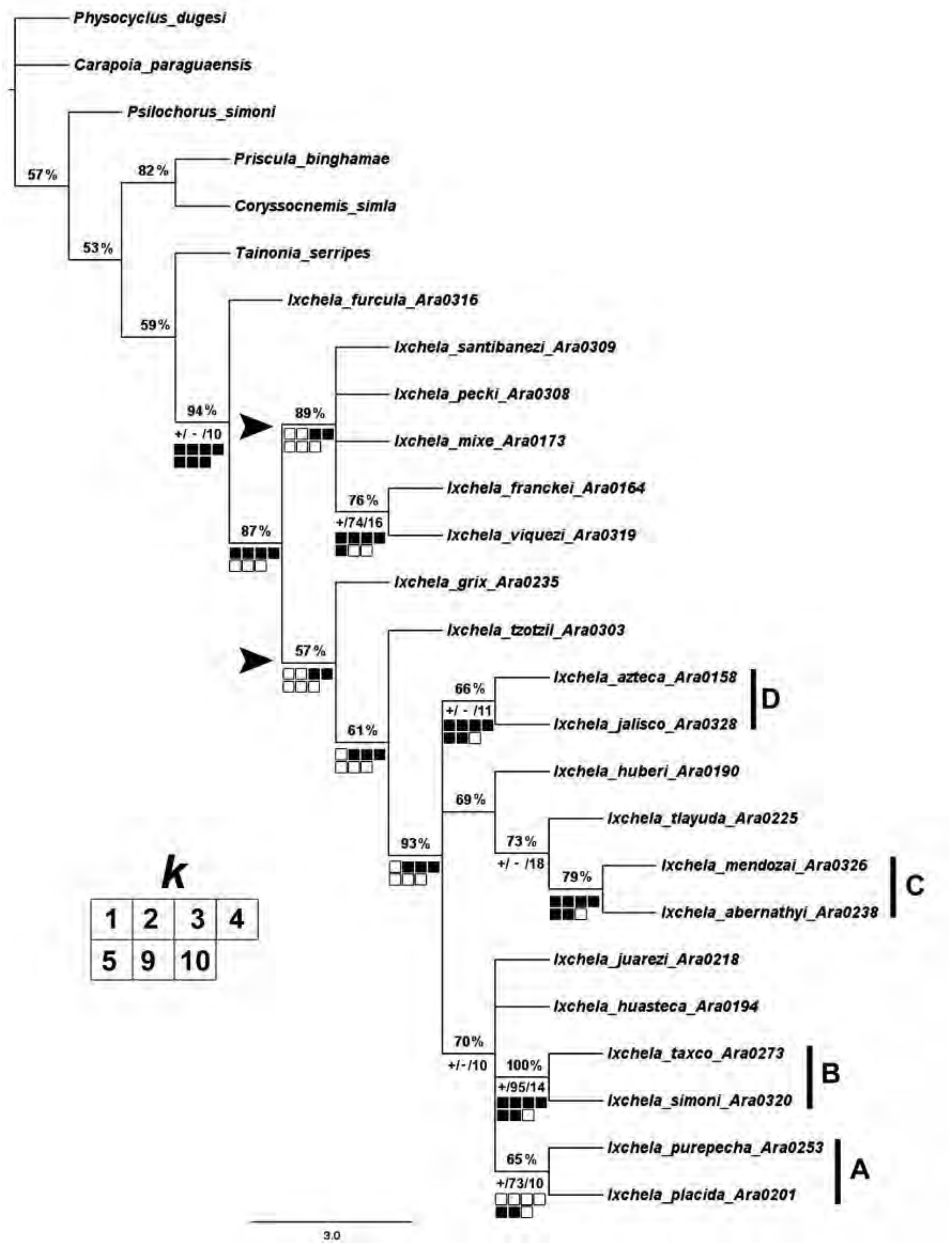


Figure 92. Majority consensus tree derived from the Bayesian analysis using the CO1 data set. Numbers above branches indicate posterior probabilities. Numbers below branches: (+) indicates clades found with PA/Jackknife support values, followed by PA/Bremer support values. Black squares below branches indicate clades recovered with PA using different concavity values (*K*) under implied weighting; white squares indicate clades not recovered with some concavity values. Letters indicate clades that are discussed in the text.

16S ribosomal RNA gene.

The 16S character matrix comprised 379 characters, 120 characters were potentially informative and 259 were uninformative and deactivated from the analysis. PA analysis with equal weighting under NONA found four most parsimonious trees (L=568, CI= 0.53, RI= 0.41). Although the strict consensus found better internal resolution than the Bayesian analysis, the tree found with BI is shown (Fig. 93). However, the monophyly of the genus *Ixchela* is not supported based on BI, due to *Coyssocnemis simla* is grouped within *Ixchela* (Fig. 93). Only three internal clades were recovered under BI and equal weighting with PA and mapped on the majority consensus tree with BI (Fig. 93). In the case of the PA analysis under equal weighting, the monophyly of the genus was recovered, however with a low Jackknife support value of 54% (Table 4).

The PA analyses under implied weighting, with the seven different concavity values although found just one most parsimonious tree not support the monophyly of the genus *Ixchela* (Table 4). The topologies found were different, and some internal relationships found with BI were recovered with most of the concavity values (black squares, Fig. 93). This was the case of the close relationship between *Ixchela pecki* + *Ixchela santibanezi* and in the clade A where *Ixchela tlayuda* + *Ixchela grix* were sister species. In comparison with the analysis under CO1, the clade A was the only recovered clade (Fig. 93).

Concatenated CO1+16S analyses.

The concatenated CO1+16S data set comprised 885 characters, 298 of which were potentially informative and 587 uninformative and deactivated for the analysis. PA analysis with equal weighting found five most parsimonious trees (L=1670, CI= 0.42, RI= 0.30). The reconstructed strict consensus tree found under PA is not shown, but the topology found with BI analysis shows the clades that were recovered under PA (Fig. 94). Although the Jackknife support value with equal weighting was considerably lower (Table 5), the Bremer support value= 7, and the posterior probability under BI analysis was considerably higher, recovered the monophyly of the genus *Ixchela* with 98% (Fig. 94).

The analyses under PA using implied weighting with concavity values (*K*= 2, 3, 4) support the monophyly of the genus with Jackknife values >64% (Table 5), and concavity values *K*= 1, 4, 5, 9, 10 found only one most parsimonious tree (Table 5).

The analysis with CO1+16S recovered similar topology than the analysis with CO1, found the same two clades but with better internal resolution (Fig. 94). The upper clade (upper arrow, Fig. 94) had better resolution than CO1, however *I. santibanezi* was found related as sister species with *Ixchela pecki* (Fig. 94). The lower clade (lower arrow, Fig. 94) was composed by the clades A, B, C, with *I. grix* and *I. tzotzil* as sister species of the rest of the clade (Fig. 94). Those clades were found under CO1 except the sister relationships between *I. purepecha* and *I. placida* (Fig. 94), but with better statistical support; for example the clade A (*I. tlayuda* (*I. mendozai* + *I. abernathyi*) was recovered with better Jackknife and Bremer support values, and with a higher value of posterior probability under BI (Fig. 94).

Table 5. Summary of the phylogenetic hypothesis with CO1+16S and combined analysis morphology+CO1+16S (CA) among the most parsimonious trees (MPT) found with equal weighting (EW) and implied weighting (IW); using seven concavity values (*K*), arranged in order of increasing fit values (*fi*). CI= Consistency index. RI= Retention index.

Analyses	**MPT CO1+16S/ CA**	**Steps CO1+16S/ CA**	**fit (*fi*) CO1+16S/ CA**	**CI CO1+16S/ CA**	**RI CO1+16S/ CA**	**Jackknife support for *Ixchela* CO1+16S/ CA**
IW: *K*= 1	1/4	1664/1612	108.14/126.17	0.42/0.45	0.31/0.33	J= 55/89
IW: *K*= 2	3/4	1648/1596	145.54/164.55	0.43/0.45	0.32/0.34	J= 73/91
EW	5/7	1626/1567	168.83/188.37	0.43/0.46	0.33/0.36	J= 15/82
IW: *K*= 3	5/4	1645/1595	169.51/188.52	0.43/0.45	0.32/0.34	J= 73/91
IW: *K*= 4	1/4	1639/1595	186.48/205.22	0.43/0.45	0.32/0.34	J= 67/91
IW: *K*= 5	1/4	1633/1589	199.27/217.62	0.43/0.45	0.33/0.34	J= 61/91
IW: *K*= 9	1/3	1628/1576	229.78/247.88	0.43/0.46	0.33/0.35	J= 45/90
IW: *K*= 10	1/4	1626/1579	234.62/251.94	0.43/0.45	0.33/0.35	J= 43/90

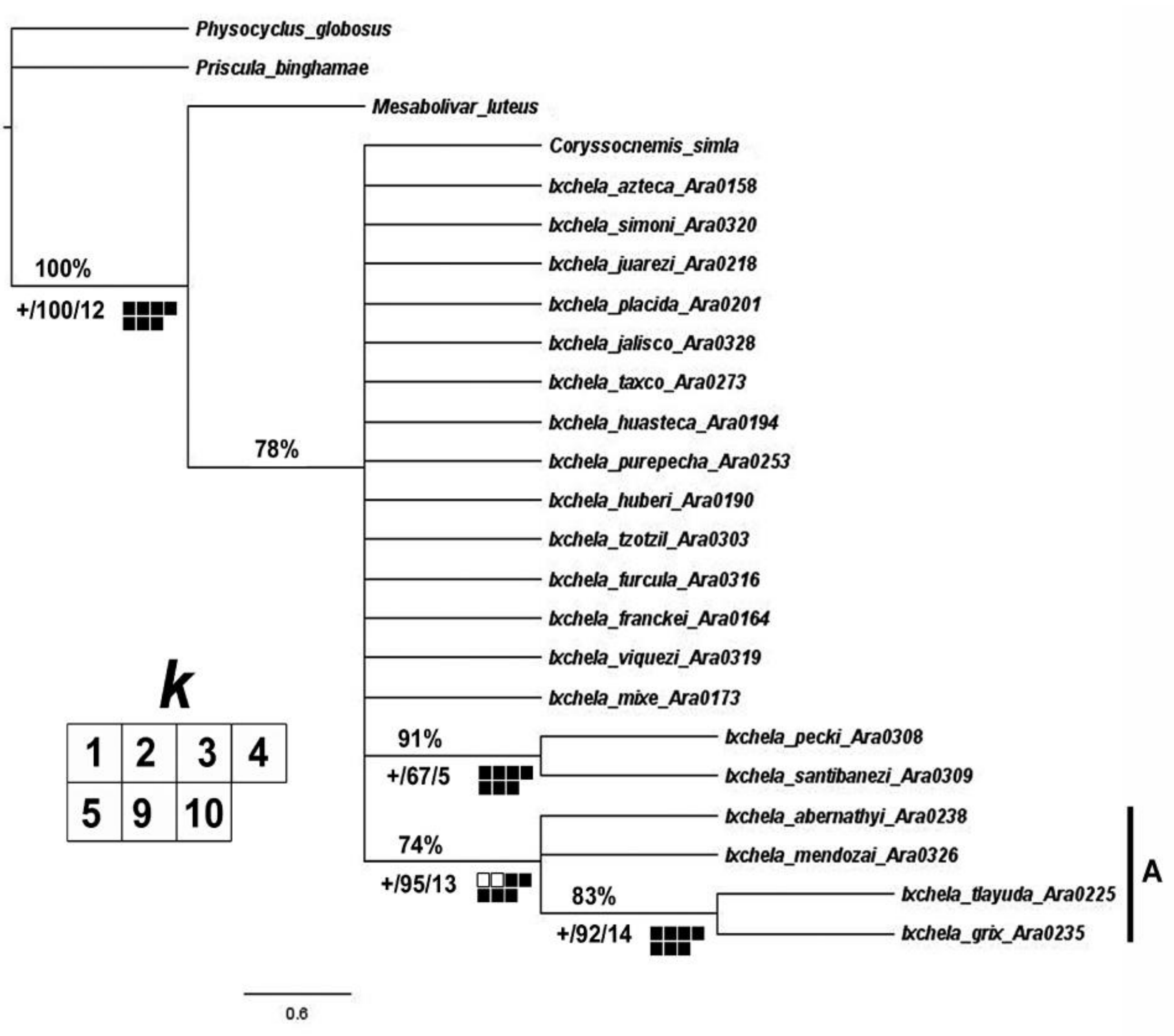


Figure 93. Majority consensus tree derived from the Bayesian analysis using the 16S gene. Numbers above branches indicate posterior probabilities. Numbers below branches: (+) indicates clades found with PA/Jackknife support values, followed by PA/Bremer support values. Black squares below branches indicate clades found with PA using different concavity values (*K*) under implied weighting; white squares indicate clades not recovered with some concavity values.

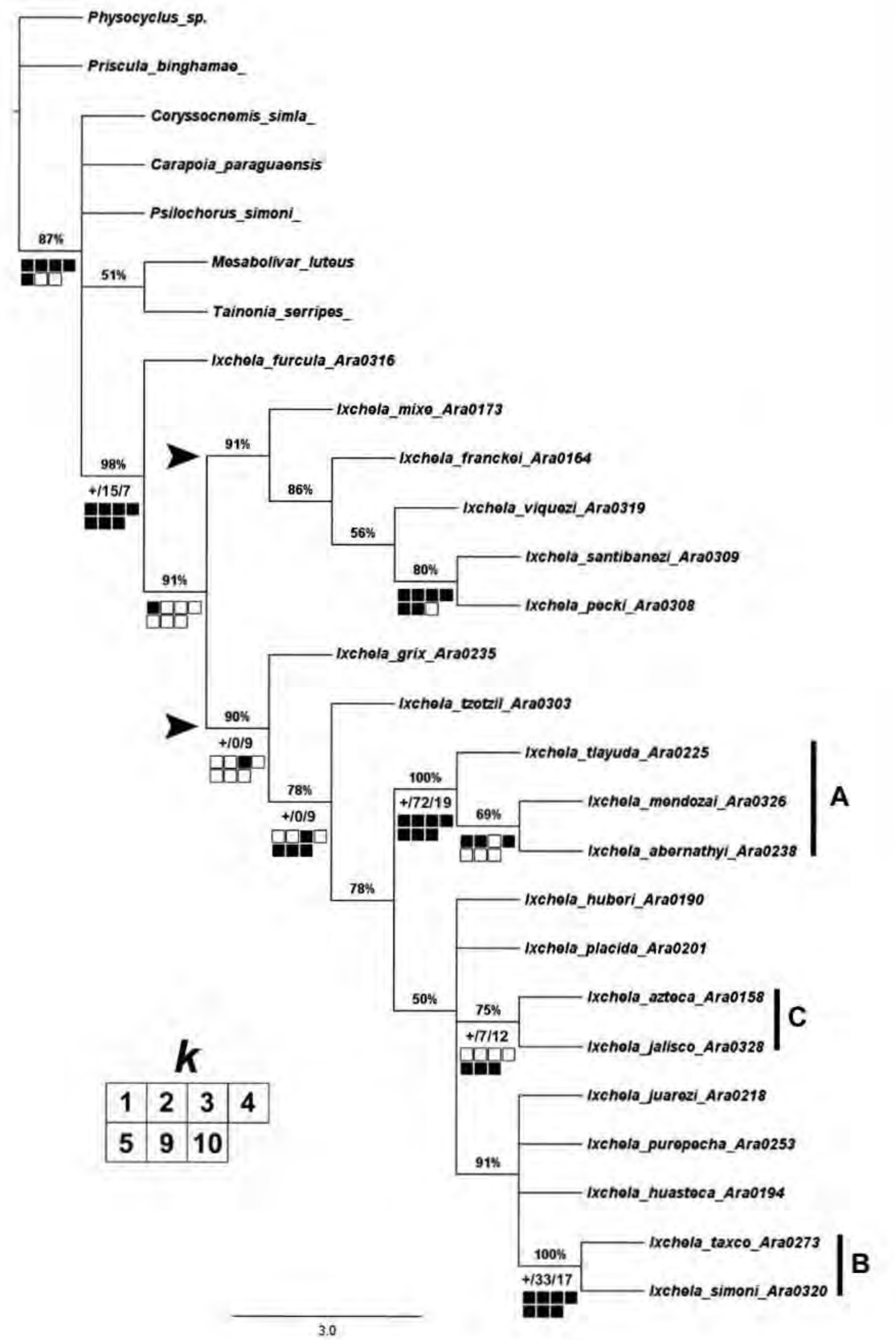


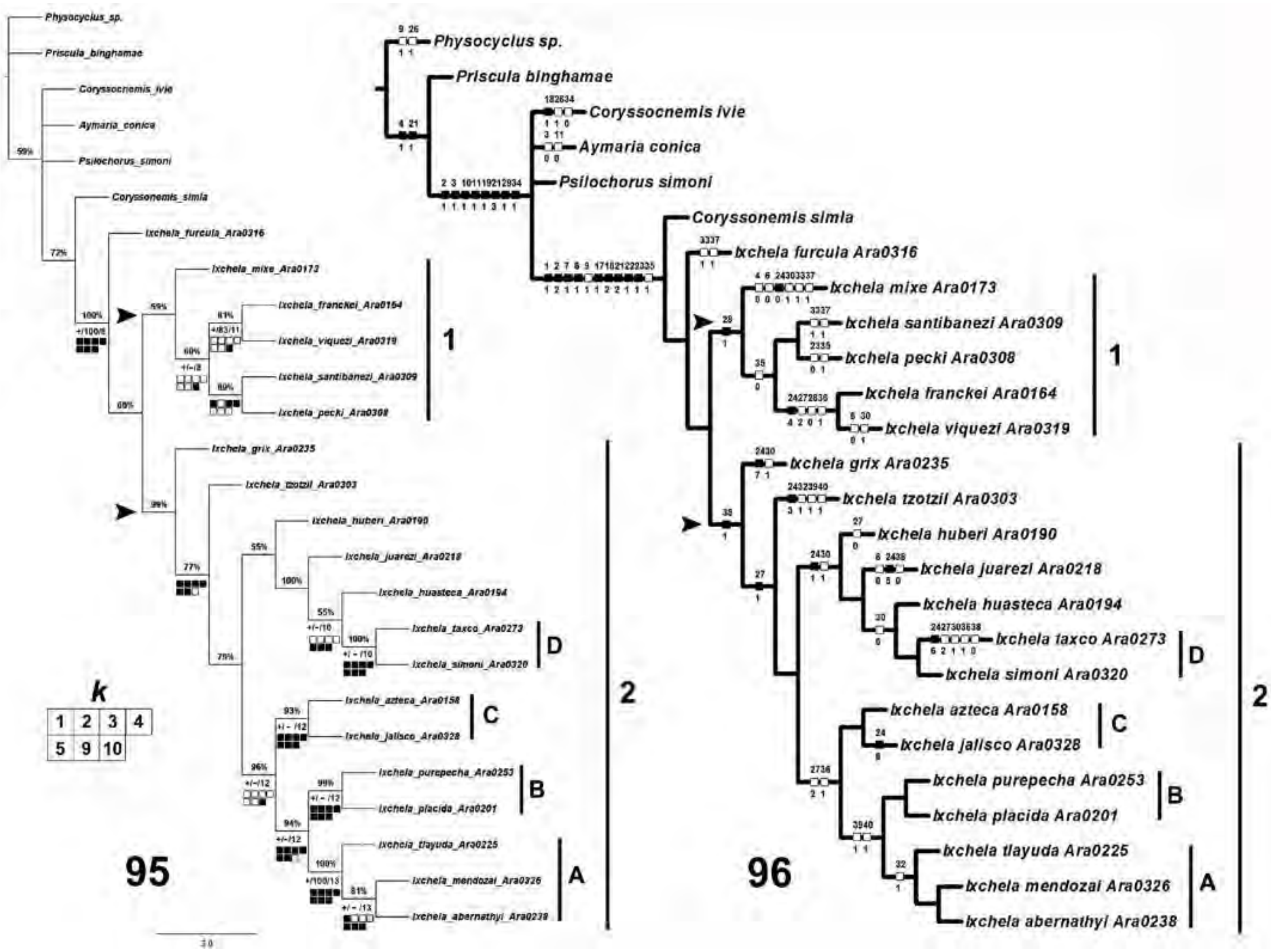
Figure 94. Majority consensus tree derived from the Bayesian analysis using the CO1+16S data set. Numbers above branches indicate posterior probabilities. Numbers below branches: (+) indicates clades found with PA/Jackknife support values with PA/Bremer support values. Black squares below branches indicate clades found with PA using different concavity values (*K*) under implied weighting; white squares indicate clades not recovered with some concavity values. Letters indicated clades that are discussed in the text.

Combined analysis (morphology+CO1+16S).

The character matrix with all available morphological and molecular information (morphology+CO1+16S) comprised 925 characters, 312 characters were potentially informative and 613 were uninformative and deactivated from the analysis. PA analysis found seven most parsimonious trees (L=1567, CI= 0.46, RI= 0.36) (Table 5). The topology found with BI analysis shows the clades that were recovered under PA (Fig. 95). Although the internal Jackknife support values were low, the monophyly of the genus is supported with a Jackknife value of 82%, Bremer value= 8, and posterior probability under BI analysis of 100%.

In the analyses under PA with implied weighting, every concavity value tested recovered the monophyly of the genus with high Jackknife support values (Table 5). The analyses with implied weighting found only four most parsimonious trees, and with *K*= 9 only three trees (Table 5).

The combined analysis recovered topologies with better internal resolution than analyses with morphology, CO1, and CO1+16S; recovering the same two clades found with CO1 and CO1+16S (Fig. 95), being the chosen final topology for discussion of the phylogeny of the genus (see discussion for phylogenetic relationchips). The morphology combined with CO1+16S contributed to give support to some clades (Fig. 95), found more robust topologies than with individual matrixes or only with combined molecular matrixes, even the morphological characters were mapped on the topology found with BI to analyze if the two clades within *Ixchela* can be diagnosed (Fig. 96), see discussion bellow.



Figures 95—96. 95, Majority consensus tree derived from the Bayesian analysis using the (morphology+CO1+16S) data set. 96, Morphological characters mapped on the consensus tree of BI. Numbers above branches indicate posterior probabilities. Numbers below branches: (+) indicates clades found with PA/Jackknife support values with PA/Bremer support values. Black squares below branches indicate clades found with PA using different concavity values (*K*) under implied weighting; white squares indicate clades not recovered with some concavity values. Letters indicated clades that are discussed in the text.

DISCUSSION

In their phylogenetic study on the spider family Pholcidae, Bruvo-Madaric *et al.* (2005) indicated in their study on the phylogeny of the spider family Pholcidae, that to generate robust phylogenetic hypotheses often requires gathering different data partitions from different sources and analyzing them in a combined data set, especially in those instances where separate genes or morphology fail to give reliable and accurate results, or give results that are at odds with each other (Ballard, 1996; Huelsenbeck *et al.*, 1996; Cameron & Williams, 2003; Dorchin *et al.*, 2004; Hebsgaard *et al.*, 2004). In the spider family Pholcidae, previous morphological phylogenetic analyses using did not completely resolved various internal relationships. In Pholcidae this applies not only to the relationships among the genera at the level of the five subfamilies, but also the internal relationships within species at the generic level; because most of the lower taxa have only autapomorphic diagnostic characters at the generic and specific levels, which complicates the codification of informative morphological characters and the phylogenetic analyses (Huber 2000, 2001, 2011). For example, in our morphological analysis, six characters were autopomorphies and deactivated of the analysis and in the case of the shape of the frontal apophysis of male chelicerae (char. 24), there were nine character states, which six characters states were autapomorphic diagnostic characters (see discussion below), which are not useful to establish the internal relationships among the species of the genus. Since Bruvo-Madaric *et al*. (2005) where was one the first phylogenetic analysis of the family Pholcidae using molecular data, it has been possible to establish more accurate phylogenetic relationships among and within the genera, and to test the usefulness of molecular evidence as a tool in the taxonomy of the family.

Morphological phylogeny.

Huber (2000) indicated that *Ixchela* resembles *Aymaria* in overall shape, because of superficial similarity and not due to synaphomorphies; however based on our phylogenetic morphological analysis we found that *Coryssocnemis ivie* is more closely related to the genus *Ixchela* (Fig. 91). The North American species that were described in the genus '*Coryssocnemis'*, such as *C. ivie*, apparently belong to a new genus (Huber, 2000; com. pers.); the real genus *Coryssocnemis* Simon, 1893 is known only from northern Venezuela and Trinidad (Huber, 2000). The confusion surrounding *Coryssocnemis* is further evidenced by the fact that the original five species included in *Ixchela* when Huber (2000) erected the genus, were initially described in that genus. Although our analysis found that '*Coryssocnemis'* was closely related to *Ixchela*, it is necessary a wider sampling of outgroups belong to Modisiminae subfamily to establish a more accurate relationships among *Ixchela* and the rest of the genera.

At the moment, the characters that supported the close relationships between the species of '*Coryssocnemis'* from North America and *Ixchela* were the ventral sclerotized line, from bulb to apical part of the embolus (char. 3); the long and wide sclerotized dorsal-retrolateral line on the embolus (char. 11); and the long setae on ventral-basal part of the procursus (char. 18, character state 1), in *Ixchela* those setae are on ventral protuberance (VPP) (char. 18, character state 2) (Figs 15, 49, 60). In addition, both genera have similar natural distribution in North America that could support the relationship. Character 35 are the sac-shaped concavities between median septum of epigynum (MSE) and pore plates (PP), that is present in *Aymaria conica* and the most of the species of *Ixchela*; however, it is a reversal character on *'Coryssocnemis' ivie*, *Ixchela santibanezi*, *Ixchela franckei*, and *Ixchela viquezi* (Fig. 91).

In the morphological analysis, the monophyly of the genus is supported by eight synapomorphies (chars. 1, 2, 7, 8, 17, 18, 21, 22) (Fig. 91). The first character is the bulb prolateroventral apophysis (PAB) on the male palp (char. 1) (Figs 1, 38, 50), which although it has different size and shape in the species, it is present in all the species of the genus. The second character that supports the genus according to the analysis is the palp femur of the male long and slender, cone-shaped (char. 2) (Figs 38, 49, 60). In comparison with the shape of the palp femur on other genera from North and Central America that share the distribution, such as *Psilochorus*, *Modisimus*, or '*Corysoccnemis'*, the shape in *Ixchela* is completely different. The ventral and dorsal apical projections on embolus (chars. 7 and 8 respectively) (Figs 2, 4, 38, 39, 63), were found in all the species of the genus, the dorsal projection is spine-shaped, whereas the ventral one is sigmoid. The shape and length of these projections is different on each species, but it cannot be considered as a diagnostic character because even within each species there is variation in the size and general shape. Other character that supports the monophyly of the genus is the distal sclerotized spine on procursus (char. 17) (Figs 38, 49, 60), which is different in each species and even within specimens of the same species, therefore it cannot be a diagnostic character at species level. The long setae present on ventral protuberance of procursus (VPP) (char. 18) (Figs 15, 38, 49), is other character that supports the monophyly; however, although these setae were present in all the species, the codification of the number of these setae was difficult because even in each specimens one palp can have two setae and the other one three setae, therefore it is a variable character. The conical, long, basally wide procursus (char. 21) (Figs 38, 49, 60) is another character that supports the monophyly of the genus; although the procursus in '*Coryssocnemis'* and *Aymaria* is similar, the conical and long shape in *Ixchela* is unique. Finally, other character that supports the monophyly is the embolus with a small sub-distally sclerotized spine ventrally (arrows Fig. 9, 63); which has a lot of variation in the shape and size among the species, even within the same species.

The monophyly of *Ixchela* is supported in the PA analyses with high Jackknife and Bremer values (100% and 8, respectively) (Fig. 91). However, there is no complete internal phylogenetic resolution within the ingroup with morphological data only; the Jackknife support values for the internal branches were low and several branches were collapsed; and *I. pecki* is recovered basally as the sister group of the rest of the genus (Fig. 91). Three internal clades were found (Fig. 91): the top clade ((*I. furcula* (*I. mixe* + *I. santibanezi*)) was supported by having the epigynum longer than wide (char. 33), and the epigynum with lateral constraints on anterior part (char. 37) (Valdez-Mondragón, 2013; figs 95, 183). Following the polarity of that character the epigynum wider than long is plesiomorphic state, whereas an epigynum longer than wide is the derived state. The second clade (middle) ((*I. huberi* + *I. grix*) (*I. huasteca* + *I. simoni*)) is supported by the shape of frontal apophysis of chelicerae, wide and rounded (char. 24) (Valdez-Mondragón, 2013; figs 74, 189), although in *Ixchela grix* the frontal apophysis of the chelicerae are small and rounded, located on central part of chelicerae (char. 24, character state 1) (Valdez-Mondragón, 2013; fig. 124) which is an autapomorphic character. The codification of the shape of the frontal apophysis of chelicerae was difficult, the frontal apophysis were conical and small on the most of the species, however in several of the species the character states of the frontal apophysis were codified as autapomorphies (e.g. *I. mixe, I. grix, I. tzotzil, I. taxco, I. jalisco*, and *I. juarezi*), having nine different character states in the matrix. Finally, the third clade (lower), with 12 species, is supported by the frontal-distal sclerotized apophyses highly visible on male chelicerae (SAC) (char. 27, character state 2) (Figs 26, 27, 37), and by small and circular concavity in frontal distal part on epigynum (char. 36, character state 1); the parsimony analysis indicates that both characters suffered reversal in *I. tzotzil* and *I. juarezi* (Fig. 91). Although the characters 39 and 40 (size and position of the lateral rounded protuberances of epigynum respectively) (Fig. 91), only *I. purepecha*, *I. placida*, and the clade ((*I. tlayuda* (*I. abernathyi* (*I. tzotzil* + *I. mendozai*)) have the lateral rounded protuberances of epigynum wide and conspicuous (char. 39, character state 1) (Figs 78, 89), and leaving a space between the protuberances and the epigastric furrow (char 40, character state 1) (Figs 66, 86). Following the polarity of these characters, they can be considered as reversal in the clade composed by (*I. franckei* (*I. taxco* (*I. juarezi* + *I. viquezi*))) (Fig. 91). There were not significant differences in the parsimony analyses with implied weighting (Table 3), and the same five most parsimonious trees, with similar statistical results, were recovered.

Molecular phylogeny

The phylogenetic analyses using molecular data (CO1 and CO1+16S) found better internal resolution that those using morphological evidence (Figs 92, 94), whereas with 16S gene under BI we found a low internal resolution (Fig. 93). For both molecular matrixes, there were a lot of uninformative characters (64% for CO1 and 68% for 16S), although the monophyly of the genus *Ixchela* was supported in all the cases with high Jackknife and Bremer support values under PA, and with significant posterior probabilities in the BI, except with 16S under BI where the monophyly was not recovered (Fig. 93). In the analysis with CO1 under PA, 145 of the 328 uninformative characters were autopomorphies, whereas with 16S 35 of the 259 uninformative characters were autopomorphies, the rest of the uninformative characters were positions without nucleotide variation. Due to the high amount of homoplastic characters that is common in molecular matrixes, we decided to implement the implied character weighting under PA to analyze the effects of weighting against homoplasy [the BI approach cannot analyze the effect of the homoplasy in the topologies analyzed because it is based on a model of sequence evolution]. We found this situation when we ran the BI analysis for 16S, the topology recovered only three internal clades within *Ixchela* (Fig. 93); however under PA (tree no shown) although not found support in the internal relationships of the species, we found a better internal resolution.

In the phylogenetic analysis with CO1, CO1+16S, and combined analysis (morphology+CO1+16S) under implied weighting with PA; the monophyly of the genus was recovered with high support (Figs 92, 94, 95). We show the topologies found only with BI analyses, indicating the same clades that were recovered in both analyses with PA (equal and implied weighting) and under BI (Figs 92-95).

About the internal phylogenetic relationships within the genus *Ixchela*, our discussion is based on the topology found with the combined analysis under BI (Fig. 95). The analysis found big two clades, being *Ixchela furcula* the sister group of the entire genus *Ixchela* (arrows, Fig. 95), the clade 1 is comprises five species: *I. mixe, I. franckei, I. viquezi, I. santibanezi* and *I. pecki* (Fig. 95); and the clade 2 comprises 14 species: *I. abernathyi, I. azteca, I. grix, I. huasteca, I. huberi, I. jalisco, I. juarezi, I. mendozai, I. placida, I. purepecha, I. taxco, I. tlayuda, I. tzotzil,* and *I. simoni* (Fig. 95). Although those clades were recovered under molecular data and supported by posterior probabilities with CO1, CO1+16S, and combined analysis (Figs 92, 94, 95); with morphological data these clades cannot be recovered (Fig. 91). Even, we mapped the morphological characters on the topology of BI with combined analysis to test if it is possible diagnosed the two clades (Fig. 96). Although the topology with the mapped character show that the morphological characters 28 and 38 could diagnose the clade 1 and clade 2 respectively (arrows, Fig. 96), these characters cannot be used to diagnose them because they are not in all the species of each clade. The character 28 (frontal and curved sclerotized apophyses on male chelicerae) are absent in *I. franckei* and *I. viquezi*; whereas the character 38 (lateral rounded protuberances of epigynum) are absent in *Ixchela juarezi* and *I. taxco* (Fig. 96). The morphological characters were mapped also in the topology found with PA for combined analysis; however they also cannot be used to diagnose both clades.

In the case of the clade 1, the posterior probability that support this clade was low, with a 59% of posterior probability; even this clade was not recovered with PA and with implied weightings (Fig. 95). Biogeographically, the species of the clade 1 have a natural distribution principally in temperate forest from Chiapas and Oaxaca toward Central America. Following the biogeographical scheme of Mexico (Morrone 2004, 2005), its distribution belongs to the Mesoamerican biotic component (mapped on yellow, Fig. 97; yellow lines Fig. 98), which are composed for the Mexican Pacific Coast, Gulf of Mexico, and mountains of Chiapas extending toward Central America (yellow lines, Fig. 98). These biogeographical distributions have been mapped in the topology of BI to represent graphically the distribution of both clades under the biotic components (Fig. 98). However, *I. mixe* and *I. franckei* have a biogeographical distribution on the Mexican Mountain biotic component as the most of the species of clade 2 (Figs 97).

About the internal relationships in the clade 1, the close relationship between *Ixchela santibanezi* + *Ixchela pecki* (Fig. 95) have close biogeographical distribution in the central part of the state of Chiapas, which could explain their close relationship. However, the habitat between both species is very different, *I. santibanezi* was collected in a tropical rainforest (Valdez-Mondragón, 2013; fig. 16), whereas *I. pecki* was collected inside a cave in a template oak forest (Valdez-Mondragón, 2013; figs 13-15, 17, 18). In the case of the close relationship between *I. franckei* + *I. viquezi* (Fig. 95), there is not a biogeographical pattern between both species; *I. franckei* has a natural geographical distribution in Guerrero state, Mexico (toward Mexican Mountain biotic); whereas *I. viquezi* has a natural distribution in Central America, specifically in Honduras (toward Mesoamerican biotic component) (Fig. 98).

In the case of the clade 2, which is strongly supported by high posterior probabilities; however the clade was not recovered under PA and the different concavity values (Fig. 95). The analyses found that *Ixchela grix* and *Ixchela tzotzil* were the sister species of the rest of clade, this was found with CO1, CO1+16S and combined evidence (Figs 92, 94, 95). The clade 2 are distributed following the biogeographical scheme of Mexico (Morrone 2004, 2005), in the Mexican Mountain biotic component (mapped on red, Fig. 97), which is composed for the Sierra Madre Occidental where is necessary to collect species in the north part (Durango, Sinaloa, Chihuahua and Sonora), Sierra Madre Oriental, Transmexican Volcanic Belt, Cuenca del Balsas, and Sierra Madre del Sur (red lines, Fig. 97). The Transmexican Volcanic Belt (TVB) (light green line, Fig. 98) is a transition zone between Nearctic and the Neotropical region, this overlapping has generated several dispersal and vicariant events in several taxa (Brooks, 2005; Halffter *et al.*, 1995; Halffter, 2003). In the case of the genus *Ixchela*, this mountain complex (the states of: Nayarit, Jalisco, Colima, Michoacán, Distrito Federal, Guanajuato, Querétaro, México, Hidalgo, Morelos, Tlaxcala, Puebla, and Veracruz) in this transition zone between Nearctic and the Neotropical region could be considered as the diversification zone of the genus (Fig. 97). Even, the species of the clade ((*I. azteca* + *I. jalisco*) ((*I. purepecha* + *I. placida*) (*I. tlayuda* (*I. mendozai* + *I. abernathyi*)))) (Fig. 97) are distributed in the TVB (Fig. 98), except *I. tlayuda* from template forest of central Oaxaca and *I. abernathyi* from Sierra Madre Oriental.

About the internal relationships in the clade 2, the clade A (*I. tlayuda (I. mendozai* + *I. abernathyi*)) (Fig. 95) which was strongly support by posterior probabilities and high Jakknife and Bremer values, besides recovered with PA and each concavity value, have a biogeographical distribution from the temperate forest of central and north of Oaxaca toward Sierra Madre Oriental in temperate forest of Puebla, San Luis Potosí, Nuevo Leon, and Tamaulipas. Although these species are phylogenetically related and with close biogeographical distribution (Fig. 97), and even morphologically are similar having femora and tibiae of legs with numerous rings (char. 32, Fig. 91); the copulatory structures as male palps and epigyna are different (Figs 56-67, 79-89; Valdez-Mondragón, 2013, figs. 19-30).

The clade B composed by *I. purepecha* and *I. placida* as sister species (Fig. 95), was strongly supported statistically, however biogeographically these species are widely separated. *Ixchela purepecha* has a natural distribution in Michoacan toward the Sierra Madre Occidental, whereas *I. placida* in Veracruz toward the Sierra Madre Oriental, although in this case this mountains complex belong to the Transmexican Volcanic Belt, which is a transition zone between Nearctic and the Neotropical region as was discussed above. The clade A and B are close related and strongly supported by high Bremer and posterior probabilities values; even under PA with the most of the concavity values (Fig. 95).

The close sister relationship between *Ixchela azteca* + *Ixchela jalisco* (clade C) was strongly supported statistically (Fig. 95). Biogeographically, both species belong to the Sierra Madre Occidental (*I. jalisco*) and the Transmexican Volcanic Belt (*I. azteca*) (Fig. 97), although there is a wide biogeographical separation between them (Fig. 90). The clade C is the sister group of the clades A + B; thereby the clade ((C (B + A)) (Fig. 95) has a biogeographical distribution in the central part of Mexico in the the Transmexican Volcanic Belt (Fig. 97).

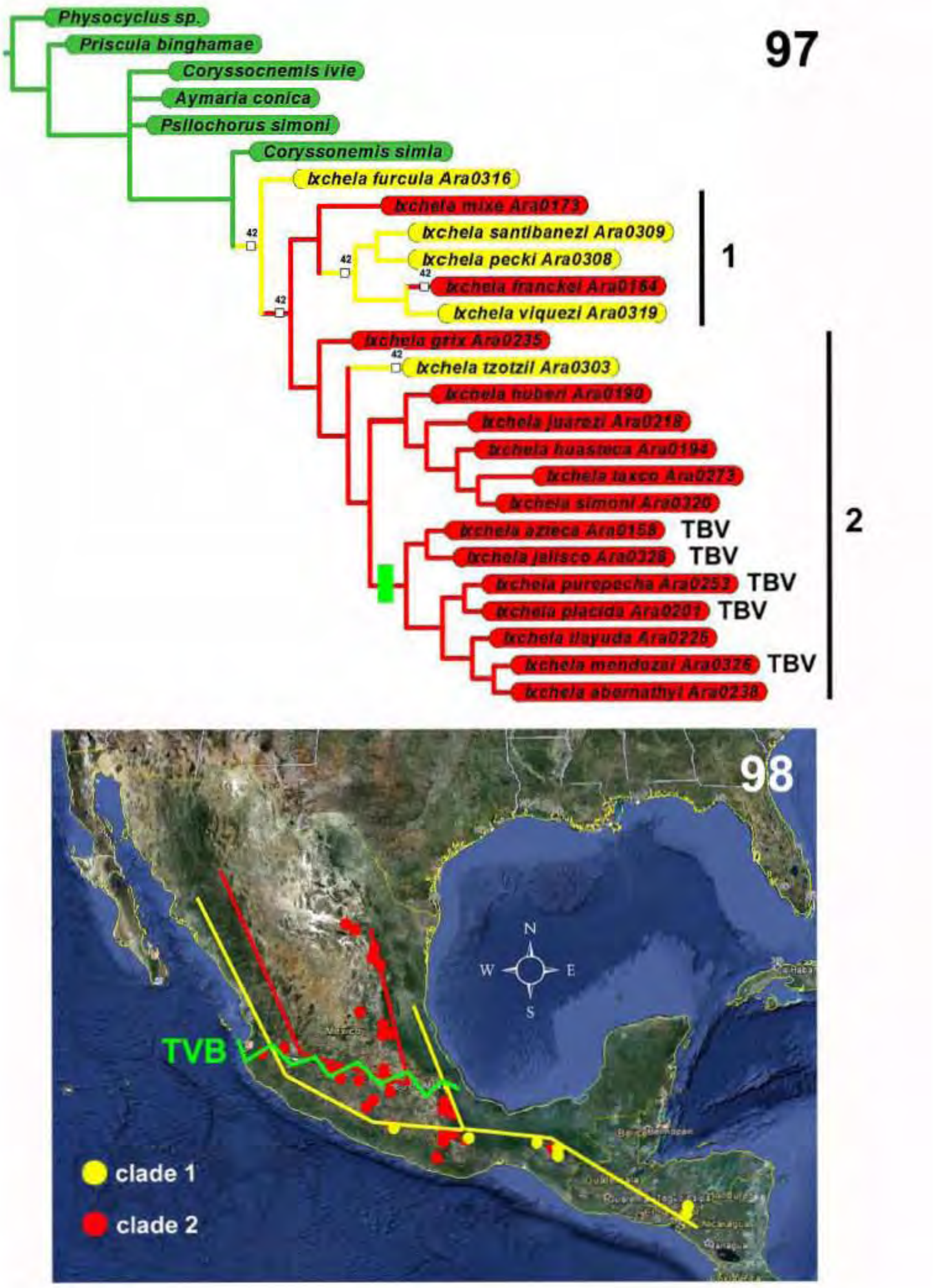
The clade D (*I. taxco* + *I. simoni*) are sister species and supported by high support values sharing a similar geographical distribution toward central template mountains of state of Guerrero, even the type localities are close together separated only for a few kilometers (Fig. 95). In the case of *Ixchela huasteca* as sister species of *I. taxco* + *I. simoni*, the natural distribution is located toward template forest of the Sierra Madre Oriental in the state of Queretaro, which belongs to the Mexican Mountain biotic component (Fig. 97).

Although the topologies found with morphology and molecular evidences were different, the internal relationships among the species of *Ixchela* were more informative principally with CO1 and when the matrixes were combined under total evidence (Fig. 95). In the case of 16S, although the phylogenetic relationships with this gene were uncertain, this molecular marker has been useful to delimit the species of the genus, which has been tested in the family Pholcidae by Astrin *et al.* (2006). However, 16S gave additional phylogenetic information in combination with CO1 and morphology, recovered some clades with better internal resolution (e.g. clades A, D and clade 1) (Fig. 95). Finally, although the number of morphological characters was considerably fewer than the molecular characters, in the analysis with total evidence, the morphology gave more support to some clades (e.g. clades A, C, D), recovered them with higher posterior probabilities, even without collapsed nodes as the analyses under CO1 and CO1+16S (Figs 92, 94).

CONCLUSIONS

The genus *Ixchela* Huber, 2000 is monophyletic and well supported by combined analysis as well as by different data partitions schemes (morphology, CO1, CO1+16S), except with 16S. PA and BI analyses support most of the internal phylogenetic relationships within the genus, found two large clades within the genus. The clade 1 that are distributed toward the Mesoamerican biotic component, and the clade 2 which is composed for the most of the species and distributed toward the Mexican Mountain biotic component. The implied weighting under PA is a useful tool to analyze a partition that is not recovered by probabilistic methods as BI approach. The phylogenetic relationships among the genus *Ixchela* and others genera of subfamily Modisiminae is not resolved totally yet, although with morphological evidence we found that the genus is close related to the species of '*Coryssocnemis'* from North America, and is necessary the molecular data of this genus to be able for corroborate the close relationships with

Ixchela. The use of others molecular markers or maybe longer region of CO1 and 16S could to corroborate the internal phylogenetic relationships in the genus *Ixchela* and with other genera of the subfamily Modisiminae.



Figures 97—98. Biogeographical distribution scheme of the clade 1 and clade 2 of the genus *Ixchela* following the biogeographical scheme of Mexico of Morrone (2004, 2005). 97, Biogeographical distribution mapped on the tree of BI. 98, Map with the biogeographical distribution each clade. Yellow color on the tree and yellow lines on map indicates the Mesoamerican biotic component (distribution of clade 1); red color on the tree and yellow lines indicates the Mexican Mountain biotic component (distribution of clade 2). Light green line on map indicates the distribution of Transmexican Volcanic Belt (TVB).

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Appendix. Character matrix used in the morphological phylogenetic analysis, composed by 24 taxa (20 ingroup, 4 outgroup), and 40 morphological characters (34 binary and six multistate), continued in the next page:

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Physocyclus dugesi	0	0	0	0	0	-	0	0	1	0	0	1	1	0	0	0	0	0	0	-
Priscula binghamae	0	0	0	1	0	-	0	0	0	0	0	1	0	1	2	0	0	0	0	-
Aymaria conica	0	1	0	1	0	-	0	0	0	1	0	0	0	1	1	1	0	0	1	1
Coryssocnemis ivie	0	1	1	1	0	-	0	0	0	1	1	0	0	1	1	0	0	1	1	1
Ixchela pecki	1	2	1	1	0	1	1	1	1	1	1	0	0	1	1	0	1	2	1	1
Ixchela furcula	1	2	1	1	0	1	1	1	1	1	1	0	0	1	1	0	1	2	1	1
Ixchela mixe	1	2	1	0	0	0	1	1	1	1	1	0	0	1	1	0	1	2	1	1
Ixchela santibanezi	1	2	1	1	0	1	1	1	1	1	1	0	0	1	1	0	1	2	1	1
Ixchela huasteca	1	2	1	1	0	1	1	1	1	1	1	0	0	1	1	0	1	2	1	1
Ixchela simoni	1	2	1	1	0	1	1	1	1	1	1	0	0	1	1	0	1	2	1	1
Ixchela huberi	1	2	1	1	0	1	1	1	1	1	1	0	0	1	1	0	1	2	1	1
Ixchela grix	1	2	1	1	0	1	1	1	1	1	1	0	0	1	1	0	1	2	1	1
Ixchela jalisco sp. nov.	1	2	1	1	0	1	1	1	1	1	1	0	0	1	1	0	1	2	1	0
Ixchela azteca sp. nov.	1	2	1	1	0	1	1	1	1	1	1	0	0	1	1	0	1	2	1	1
Ixchela purepecha sp. nov.	1	2	1	1	0	1	1	1	1	1	1	0	0	1	1	0	1	2	1	1
Ixchela franckei	1	2	1	1	0	1	1	1	1	1	1	0	0	1	1	0	1	2	1	1
Ixchela taxco	1	2	1	1	1	1	1	1	1	1	1	0	0	1	1	0	1	2	1	1
Ixchela juarezi	1	2	1	1	0	0	1	1	1	1	1	0	0	1	1	0	1	2	1	1
Ixchela viquezi	1	2	1	1	0	0	1	1	1	1	1	0	0	1	1	0	1	2	1	1
Ixchela placida	1	2	1	1	0	1	1	1	1	1	1	0	0	1	1	0	1	2	1	1
Ixchela tzotzil	1	2	1	1	0	1	1	1	1	1	1	0	0	1	1	0	1	2	1	1
Ixchela tlayuda sp. nov.	1	2	1	1	0	1	1	1	1	1	1	0	0	1	1	0	1	2	1	1
Ixchela abernathyi	1	2	1	1	0	1	1	1	1	1	1	0	0	1	1	0	1	2	1	1
Ixchela mendozai sp. nov.	1	2	1	1	0	1	1	1	1	1	1	0	0	1	1	0	1	2	1	1

Continued.

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
0	0	0	-	0	1	0	0	0	0	1	0	0	0	-	0	0	0	-	-
1	0	0	-	0	0	0	0	0	0	0	0	0	0	-	0	0	0	-	-
3	0	0	-	1	0	0	0	1	0	0	0	0	1	0	0	0	0	-	-
3	0	0	-	0	1	0	0	1	0	0	0	0	0	-	0	0	0	-	-
2	1	0	-	0	0	0	1	1	0	0	0	0	1	1	0	0	0	-	-
2	1	1	2	0	0	0	0	1	0	0	0	1	1	1	0	1	0	-	-
2	1	1	0	0	0	0	1	1	1	0	0	1	1	1	0	1	0	-	-
2	1	1	2	0	0	0	1	1	0	0	0	1	1	0	0	1	0	-	-
2	1	1	1	0	0	1	0	1	0	0	0	0	1	1	0	0	1	0	0
2	1	1	1	0	0	1	0	1	0	0	0	0	1	1	0	0	1	0	0
2	1	1	1	0	0	0	0	1	1	0	0	0	1	1	0	0	1	0	0
2	1	1	7	0	0	0	0	1	1	0	0	0	1	1	0	0	1	0	0
2	1	1	8	0	0	2	0	1	0	0	0	0	1	1	1	0	1	0	0
2	1	1	2	0	0	2	0	1	0	0	0	0	1	1	1	0	1	0	0
2	1	1	2	0	0	2	0	1	0	0	0	0	1	1	1	0	1	1	1
2	1	1	4	0	0	2	0	1	0	0	0	0	1	0	1	0	0	-	-
2	1	1	6	0	0	2	0	1	1	0	0	0	1	1	1	0	0	-	-
2	1	1	5	0	0	1	0	1	1	0	0	0	1	1	0	0	0	-	-
2	1	1	4	0	0	2	0	1	1	0	0	0	1	0	1	0	0	-	-
2	1	1	2	0	0	2	0	1	0	0	0	0	1	1	1	0	1	1	1
2	1	1	3	0	0	1	0	1	0	0	1	0	1	1	0	0	1	1	1
2	1	1	2	0	0	2	0	1	0	0	1	0	1	1	1	0	1	1	1
2	1	1	2	0	0	2	0	1	0	0	1	0	1	1	1	0	1	1	1
2	1	1	2	0	0	2	0	1	0	0	1	0	1	1	1	0	1	1	1

4. DISCUSION GENERAL

La diversidad de arañas de la familia Pholcidae en México esta compuesta actualmente por 13 géneros y 179 especies. Sin embargo, mucha diversidad perteneciente a esta familia sigue aún sin ser conocida, ya que existen muchas zonas del país donde aún hacen falta muestreos intensivos para poder conocer la diversidad de estas arañas. Aunque la mayor diversidad de estas arañas esta concentrada hacia los trópicos y subtrópicos del país, los bosques templados han resultado ser bastante diversos en cuanto al número de género y especies que podemos encontrar. Para el caso del género de arañas *Ixchela* Huber, 2000, el conocimiento respecto a su diversidad se incrementó considerablemente de cinco a 20 especies formalmente descritas. Aunado a lo anterior, nueva evidencia morfológica fue registrada en este estudio. Por una lado, se comprobó que las amplias distribuciones que previamente a este trabajo se creían para especies como *Ixchela simoni* (O.-P. Cambridge, 1898) o *Ixchela furcula* (F. O. P. Cambridge, 1902), se trataban en realidad de especies nuevas que no habían sido descritas. La recolecta intensiva de series numerosas de ejemplares en campo permitió el estudio de la variación intraespecífica e interespecífica, con lo cual se corroboró, que la evidencia morfológica, en este caso la forma tanto externa como interna de los órganos copulatorios en este género de arañas, sigue siendo una evidencia robusta para la identificación y la delimitación morfológica de las especies. Por otra parte, la utilización de genes mitocondriales, en este caso citocromo oxidasa c subunidad 1 (CO1) y 16S, dadas sus tasas de sustitución, permiten poner a prueba la identificación y delimitación de las especies basadas previamente en caracteres morfológicos. Esta herramienta para este estudio, corroboró la validez de las especies del género *Ixchela* previamente delimitadas e identificadas solamente por caracteres sexuales, como quelíceros y pedipalpos en los machos, como epiginios en las hembras. Para poder corroborar la evidencia molecular como una herramienta en la delimitación de especies, se realizaron análisis fenéticos de agrupamiento por similitud genética, que en el caso del gen CO1 se observaron mejores valores de soporte de Bootstrap en comparación con 16S, sin embargo, ambos genes sustentan las especies diagnosticadas y descritas previamente.

Respecto a las relaciones filogenéticas del género *Ixchela*, tanto la evidencia morfológica como la evidencia molecular, soportan la monofilia del género. En el caso de la filogenia llevada a cabo solamente con datos morfológicos con una matriz de 40 caracteres, en análisis encontró cinco cladogramas igualmente parsimoniosos, soportando la monofilia del género con ocho sinapomorfías. Sin embargo, basados en esta evidencia, las relaciones filogenéticas internas entre las especies del género no fueron claras. De manera general, las arañas de la familia Pholcidae, son arañas morfológicamente homogéneas, y aunque los géneros están soportados por varios caracteres diagnósticos, de manera general, los estudios filogenéticos previos basados en morfología carecen de resolución interna entre las especies. Debido a esto, el poder establecer a ciencia ciertas cuales son las relaciones filogenéticas interespecíficas resulta complicado. En el caso del género *Ixchela* no fue la excepción, aunque morfológicamente su monofilia fue soportada por ocho sinapomorfías y altos valores de soporte de Jackknife y Bremer, la resolución interna fue pobre y poco soportada por dichos valores.

En relación a los análisis filogenéticos llevados a cabo con evidencia molecular (CO1 y 16S), dicha evidencia generó mayor información a nivel interno dentro las relaciones filogenéticas entre las especies. Con el uso ambos genes motocondriales, tanto los análisis filogenéticos con Parsimonia como con análisis Bayesiano para COI (506 caracteres), como para 16S (379 caracteres) soportan la monofilia del género, a pesar de que el 64% de los caracteres para COI, y el 68% para 16S fueron caracteres homoplásicos y no informativos. Respecto a los análisis filogenéticos utilizando evidencia combinada con MP como con análisis Bayesiano, tanto la matriz concatenada de COI+16S (885 caracteres) como el análisis combinado: morfología+COI+16S (925 caracteres) soportan la monofilia del género *Ixchela* encontrando mejor resolución interna entre las especies. Las diferentes hipótesis encontradas con MP y Bayesiano recuperaron la mayor parte las relaciones internas del genero *Ixchela*, incluso muchos de los análisis que se llevaron a cabo utilizando diferentes valores de concavidad (*K*) con MP, recuperaron varios de los clados internos. Basados en la topología recuperada bajo Inferencia Byeasiana para análisis combinados que fue la elegida para explicar la filogenia de *Ixchela*; dentro del género *Ixchela* se encontraron dos clados o linajes, el clado 1 y el clado 2, siendo *Ixchela furcula* la especie hermana del resto del género. El clado 1 esta compuesto por cinco especies: *I. mixe, I. franckei, I. viquezi, I. santibanezi* and *I. pecki*; y el clado 2 comprises 14 especies: *I. abernathyi, I. azteca, I. grix, I. huasteca, I. huberi, I. jalisco, I. juarezi, I. mendozai, I. placida, I. purepecha, I. taxco, I. tlayuda, I. tzotzil*, e *I. simoni*.

Analizando sus patrones biogeográficos, el clado 1 esta distribuído en el componente biótico Mesoamericano, mientras que clado 2 esta distribuído hacia el componente biótico Mexicano de Montaña. Esto nos habla de que en el Eje Volcánico Transversal que abarca los estados de Nayarit, Jalisco, Colima, Michoacán, Distrito Federal, Guanajuato, Querétaro, México, Hidalgo, Morelos, Tlaxcala, Puebla, y Veracruz, que es la transición entre le región Neártica y la Neotropical, probablemente sea la zona de diversificación del género *Ixchela*.

A pesar de la evidencia morfológica y molecular que soportan la monofilia del género *Ixchela*, es necesario aún un muestreo más amplio de otros géneros pertenecientes a la subfamilia Modisiminae, esto para poder establecer a ciencia cierta cuales son las relaciones filogenéticas del género con respecto a otros géneros de la subfamilia. Quizá el uso de otros marcadores moleculares o de regiones mas amplias de los genes mitocondriales CO1 y 16S permitirán dar más robustez no solamente a las a las relaciones internas del género *Ixchela*, sino además establecer cual es su grupo hermano o más relacionado filogenéticamente, esto claro, con un mayor muestreo de terminales pertenecientes a otros géneros.

5. CONCLUSIONES

- La diversidad conocida del género *Ixchela* Huber, 2000 se incremento de cinco especies a 20 especies descritas, lo que equivale a un 400% más de lo que se conocía previo a este estudio.

- La taxonomía a nivel de especie del género *Ixchela* está soportada robustamente tanto por caracteres morfológicos (pedipalpos y la forma de quelíceros en los machos, y características internas y externas en los epiginios de las hembras), como por caracteres moleculares, en este caso con el uso de marcadores mitocondriales CO1 y 16S.

- El género *Ixchela* es un grupo natural o monofílético, robustamente soportado tanto por caracteres morfológicos, como por caracteres moleculares (CO1 y 16S).

- Hubo una mejor señal filogenética con evidencia molecular que con evidencia morfológica, encontrando mejor resolución interna entre las relaciones filogenéticas de las especies del género.

- El género *Ixchela* esta conformado por dos clados o linajes, el primero distribuído en el componente biótico Mesoamericano; y el segundo en el componente Mexicano de Montaña, siendo la transición entre le región Neártica y la Neotropical (Eje Neovolcánico Transversal), la zona de diversificación del género *Ixchela*.

- Entre las particiones llevadas a cabo para hacer los análisis filogenéticos: CO1, 16S, CO1+16S, y análisis combinado (morfología+CO1+16S); el análisis llevado a cabo con análisis combinado tanto con Parsimonia utilizando pesos implicados como con análisis Bayesiano, encontró hipótesis con mejor resolución y mejor soportadas por los diferentes valores (Jackknife, Bremer, y probabilidades posteriores).

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Two new species of spiders of the genus *Selenops* Latreille, 1819 (Araneae: Selenopidae) and redescription of *Selenops scitus* Muma, 1953 from Mexico

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Abstract

Two new species of *Selenops* Latreille, 1819 from Mexico are described: *Selenops aztecus* **sp. nov.** from the state of Veracruz, known only from a single male, and *Selenops santibanezi* **sp. nov.** from the state of Oaxaca, known from both sexes. *Selenops scitus* Muma, 1953, originally described only from the female holotype from Guerrero, México is redescribed and the male of this species is described for the first time; new records of its distribution are given.

Key words: *Selenops*, Taxonomy, Veracruz, Oaxaca, Guerrero

Resumen

Dos especies nuevas de *Selenops* Latreille, 1819 de México son descritas: *Selenops aztecus* **sp. nov.** del estado de Veracruz, conocida solamente por el macho; y *Selenops santibanezi* **sp. nov.** del estado de Oaxaca, conocida por el macho y la hembra. *Selenops scitus* Muma, 1953, descrita originalmente solo del holotipo hembra de Guerrero, México es redescrita y el macho de esta especie es descrito por primera vez; nuevos registros de su distribución son proporcionados.

Palabras clave: *Selenops*, Taxonomía, Veracruz, Oaxaca, Guerrero

Introduction

The family Selenopidae Simon, 1897 contains five genera. The type genus *Selenops* Latreille, 1819, is a diverse group of spiders distributed in tropical, subtropical and temperate regions around the world, with 117 species described to date (Platnick 2009). *Selenops* is the only genus of the familyfound in the New World. The natural distribution of this genus covers all the tropical and subtropical regions of North America such as Florida, Texas, New Mexico, Arizona, southern California (including the Peninsula of Baja California) and reaches Northern Argentina and Paraguay in the south (Muma 1953; Crews 2005).

The spiders of *Selenops* can be found in diverse types of vegetation, from dry desert and chaparral to tropical forests (Crews 2005), from sea level to around 2000 meters elevation. These spiders are commonly found under bark, under or on stones, trunks, and debris on the ground, between the bases of the leaves of tropical plants, occasionally inside tree trunks, entrances of caves, and on flat surfaces and in narrow cracks and crevices (Muma 1953; Valdez-Mondragón 2007). They are common inside human buildings: Macleay (1839) reported *Selenops celer* Macleay, 1839 as common on walls of buildings in Cuba; Gertsch (1949) reported *Selenops* (probably *S. mexicanus* Keyserling, 1880) on houses in Panama. *Selenops mexicanus* is common and abundant in Mexican cities, like Oaxaca where it is found inside the houses and buildings, living with other spiders like the pholcid *Physocyclus dugesi* Simon, 1893, and they could be the pray of this one (*pers. observ.*). They are nocturnal and do not build webs (Crew 2005).

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The taxonomic history begins with Walckenaer (1837) who proposed three groups based on the cheliceral morphology, the shape of the labium and the leg lengths. Simon (1880) did not corroborate those three groups, and separated the Old and New World species based the eye size. Pickard-Cambridge (1905) separated the species of the Western Hemisphere using the position and the size of the eyes in addition to the genitalic characters (Crews 2005). The most important work on this genus for North and Central America and the Caribbean was conducted by Muma (1953), who proposed six species groups, based on the leg lengths, the position and the size of the eyes and the genitalic characters.

In Mexico there are 16 species recorded, including the two new ones that are described below. These species belong to three groups: the *debilis*, *lindborgi*, and *mexicanus* groups (Muma 1953; Valdez-Mondragón 2007).

Material and methods

The epigynes of the females and the palps of the males were dissected in ethanol (80%) and cleared in potassium hydroxide (KOH-10%) for 10 to 15 minutes. Habitus, chelicerae, epyginae and palps were submerged in 96% gel alcohol and covered with a thin layer of liquid ethanol (80%) to minimize diffraction during photography and drawings. A dissecting microscope Nikon SMZ645 was used to observe and to take the photographs. The photographs were taken with a camera Nikon Coolpix S10 VR with adapter for the microscope. A dissecting microscope Zeiss Stemi SV11 with a camera lucida attached was used to make the drawings. The photographs, drawings and the map were edited using Adobe Photoshop CS2 Version 9.0. The map was made with Microsoft Encarta Encyclopedia Standard Edition (Microsoft Corporation 1993-2009). The specimens used in this study are deposited in ethanol (80%) in the Colección Nacional de Arácnidos (CNAN) of the Instituto de Biología, Universidad Nacional Autónoma de México (UNAM).

All measurements are in millimeters. Abbreviations of morphological terms as follow: ALE, anterior lateral eyes; ALS, anterior lateral spinnerets; AME, anterior median eyes; C, cymbium; CD, copulatory duct; E, embolus; MS, median septum; MA, median apophysis; P, promargin; PLE, posterior lateral eyes; PLS, posterior lateral spinnerets; PME, posterior median eyes; R, retromargin; RTA, retrolateral tibial apophysis; S, spermatheca; T, tegulum; VTA, ventral tibial apophysis. Spines formula: v, ventral; d, dorsal.

Taxonomy

Family Selenopidae Simon, 1897

Genus *Selenops* Latreille, 1819

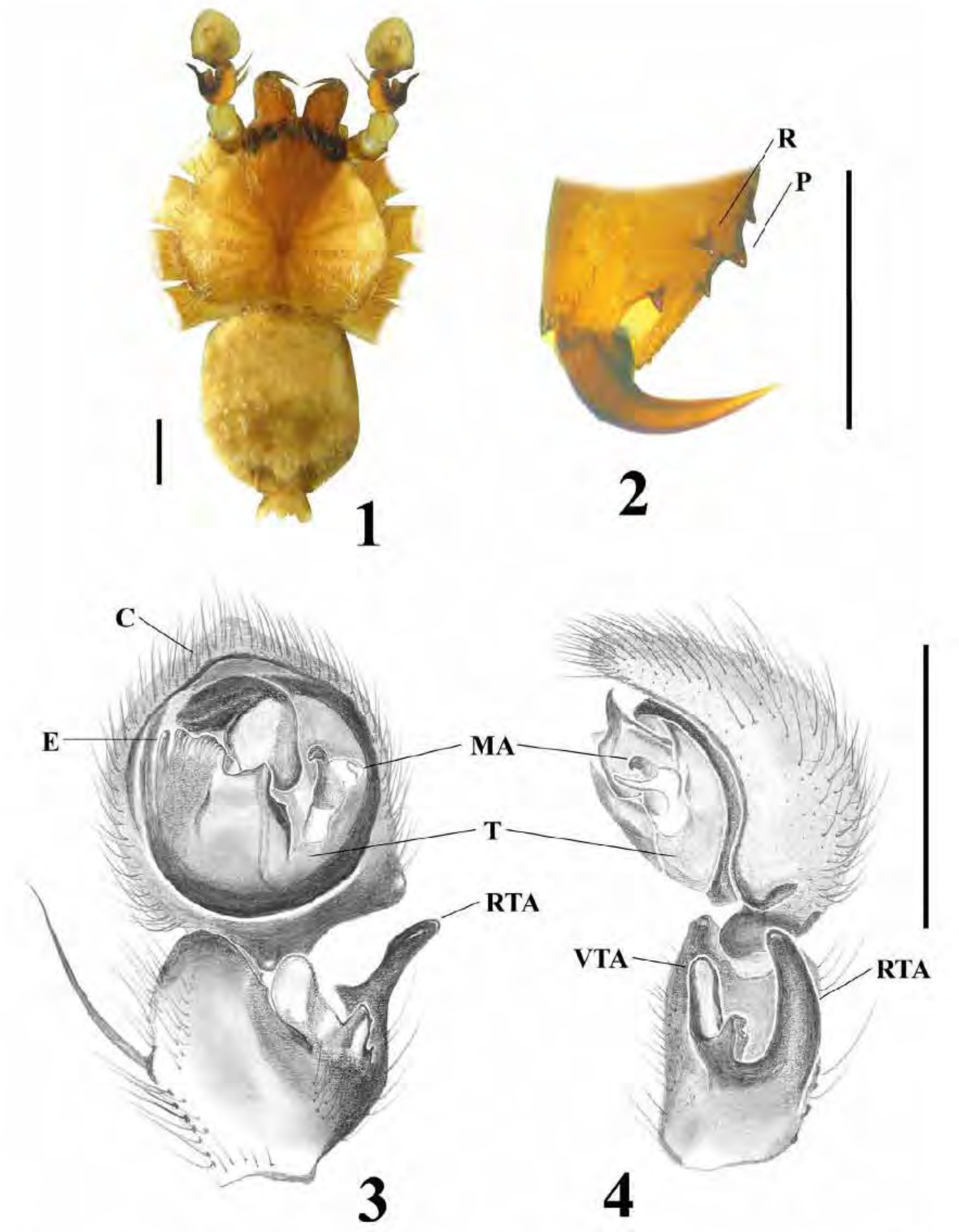
Selenops radiatus Latreille, 1819 (Type species)

Selenops differs from other selenopid genera by the following characters: The anterior median eyes (AME), posterior median eyes (PME) and anterior lateral eyes (ALE) aligned or slightly recurved, with the PME equal or subequal in size to AME. Leg II > leg IV; tibiae and metatarsi I-II with spines formula v2-2-2 and v2-2, respectively. Male palp with a retrolateral tibial apophysis (RTA) and ventral tibial apophysis (VTA). Median apophysis (MA) small and simple with one or two projections. Epigynum of the female with central area well developed, with distinct lateral lobes and epigynal pockets bigger than genital openings (Corronca 2002).

Selenops aztecus new species

Figures 1–4

Type material: Holotype: male, 14 km from Coatzacoalcos-Villa Hermosa, Tabasco; on bromeliad *Aechmea* *bracteata* (Sw.) Griseb. (Poales: Bromeliaceae) in the corolla, at 5 meters above the ground [Veracruz, Mexico], 1 February 1971, (CNAN-T0414).



FIGURES 1–4. *Selenops aztecus* **new species.** Male (Holotype). 1 Habitus, dorsal view; 2 Left chelicera, teeth of promargin and retromargin view; 3 Left palp, ventral view; 4 Left palp, retrolateral view. Scales= 1 mm.

Other material examined. One immature specimen, same data as holotype (CNAN 3229).

Etymology. The specific name is dedicated to the Aztecs, a Mesoamerican culture centered in Mexico from about 1428 to 1521.

Diagnosis. Male can be distinguished by the exclusive shape of the VTA, which is bifurcated, the inner lobe is longer and tongue-shaped and the external lobe is shorter and triangular (Fig. 3). The RTA is long and thin distally, it has an upside-down boot-shape (Fig. 3), and curved slightly in retrolateral view (Fig. 4).

Description. Male (Holotype): Carapace orange, circular, ocular region darker (Fig. 1). Carapace with numerous setae on the margin, and shallow longitudinal fovea. Clypeus slightly shorter than diameter of ALE. Chelicerae dark brown. Promargin of the chelicerae with only three teeth, separated by the same distance, the middle one bigger; retromargin with two teeth, widely separated (Fig. 2). Sternum round, yellow, orange in the margins. Labium dark orange, paler basally, wider than long, not merged with the sternum. Gnathocoxae orange, paler than labium, lighter distally, trapezoidal in shape. Opisthosoma pale gray dorsally, dark gray around the edges, ventrally pale orange. ALS and PLS gray in retrolateral part.

Palps. Curved RTA, as long as tibia (Figs 3, 4). Embolus short, near to prolateral part of cymbium (Fig. 3).

Legs. Coxae orange, longer than wide. Femora and tibiae orange, with faint dusky bands. Patellae basally dark orange. Spine formulae: Tibiae I: v2.2.2; [leg II missing on both sides]; III-IV: v1.1; metatarsi I: v2.2; [leg II missing]; III-IV: v2.1. Femora I: d1.1.1; II missing; III-IV: d1.1.1.

Measurements. Total length (prosoma + opisthosoma): 8.60, prosoma: 3.95 long, 4.40 wide. Diameter of eyes: AME 0.32, ALE 0.16, PME 0.30, PLE 0.42. Leg lengths: I: femur 4.85/ patella 2.10/ tibia 4.60/ metatarsus 4.25/ tarsus 1.90/ total 17.70; [leg II missing]; III: 6.00/ 2.08/ 5.15/ 4.60/ 1.80/ 19.63; IV: 5.30/ 2.00/ 5.25/ 4.58/ 1.75/ 18.88. Formula: 2341?

Female: Unknown.

Distribution. Only known from the type locality (Fig. 20).

Remarks. Following Muma (1953), *Selenops aztecus* **sp. nov.** belongs to the *mexicanus* group by having RTA long, slender, extending beyond the base of the cymbium; the median apophysis has two hook-shaped projections, located medially near to retrolateral margin; by having a thin, sheet-like, terminal apophysis extending beyond the embolus, near the distal part of the cymbium (Figs 3, 4), and maybe by the leg formula 2341 characteristic for this group. Four species belong to the *mexicanus* species group: *Selenops mexicanus* Keserling, 1880; *S. galapagoensis* Banks, 1902; *S. gracilis* Muma,1953 and *S. tehuacanus* Muma, 1953;

Selenops aztecus resembles *S. tehuacanus* in the shape of the median apophysis and in total size, but in this new species the RTA is shorter than in *S. tehuacanus*, where it extends distally almost to the positionof MA. The VTA in the new species is bifurcated and wider than in *S. tehuacanus*. The new species has carapace and legs with light color, whereas *S. tehuacanus* has dusky color pattern.

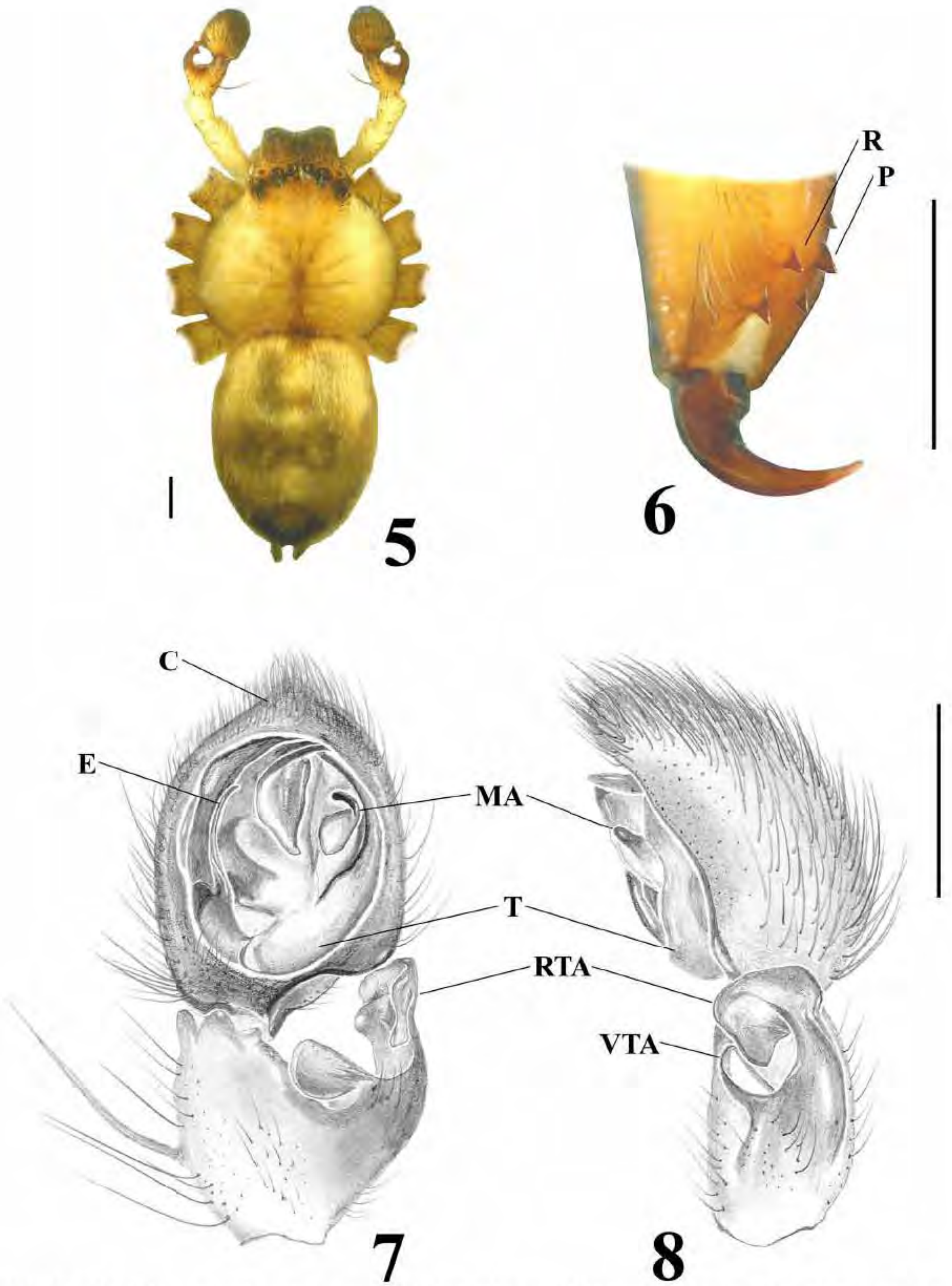
Note: Muma (1953) did not illustrate the male palp of *S. tehuacanus*. The holotype is deposited in the American Museum of Natural History (AMNH), New York; and was compared with *Selenops aztecus* by means of photographs amiably provided by Nadine Dupérré, assistant of the Dr. Norman I. Platnick (AMNH). These images corroborate the specific distinctiveness of *S. aztecus* **sp. nov.**

Selenops santibanezi new species

Figures 5–11

Type material: Holotype: male, from Santa Catarina Ixtepeji, [lat 17.28°, lon -96.54496667°, 2021 m; Municipio Santa Catarina Ixtepeji, Distrito Ixtlán, Oaxaca, Mexico], 19 September 2009, A. Valdez, R. Paredes, C. Santibáñez Cols. (CNAN-T0415).

Other material examined: female paratype, from same locality as holotype, 17 March 2008, A. Valdez, H. Montaño, C. Santibáñez Cols. (CNAN-T0625). Two females paratypes, same data as holotype (CNAN-T0626). Five immatures, same locality as holotype (CNAN 3230). Three immatures from Road to Santa Catarina Ixtepeji [lat 17.2796333°, lon 96.5447666°, 1951 m; Municipio Santa Catarina Ixtepeji, Distrito Ixtlán, Oaxaca, Mexico], 17 June 2007, A. Valdez, C. Santibáñez Cols. (CNAN 3231). One immature (Ara-0007) for DNA, from same data as holotype.



FIGURES 5–8. *Selenops santibanezi* **new species**. Male (Holotype). 5 Habitus, dorsal view; 6 Left chelicera, teeth of promargin and retromargin view; 7 Left palp, ventral view; 8 Left palp, retrolateral view. Scales= 1 mm.

Etymology. This species is dedicated to the scorpionologist and friend Carlos Eduardo Santibáñez López, for his contribution to the knowledge of the arachnids from Oaxaca, Mexico, and his participation in the collecting of the type series.

Diagnosis. Males can be distinguished by the exclusive shape of the RTA and VTA: RTA is short and distally with axe-shape in retrolateral view (Figs 7, 8); VTA is wide and oval in ventral view (Fig. 7). Females can be distinguished by the wide vertical median septum of the epigynum, and by the thin vertical concavity near to epigastric furrow (Fig. 10).

Description. Male (Holotype). Carapace orange with ocular region dark orange (Fig. 5). Caparace with three thin gray lines, little visible, towards each side (Fig. 5). Fovea Y-shaped extending anteriorly and merging with the posterior part of ocular region (Fig. 5). Clypeus slightly shorter than diameter of AME. Chelicerae orange, with dark region in distal part. Promargin of the chelicerae with only three teeth, the middle one bigger, middle one closer to basal than to distal; retromargin with two teeth of same size (Fig. 6). Sternum round, pale orange, darker posteriorly. Labium dark orange, wider than long, not merged withthe sternum. Gnathocoxae of the same color as sternum, trapezoid in shape. Opisthosoma orange, darker than carapace, dark around the edges and with a dark region near to spinnerets (Fig. 5). Opisthosoma ventrally dark orange. ALS and PLS orange, dark in retrolateral part.

Palps. RTA short, as long a tibia; VTA wide, ventrally oval, strait in the base (Figs 7, 8). Embolus long and thin, near to prolateral part of cymbium (Fig. 7).

Legs. Coxae yellow, longer than wide. Femora-tarsus orange, femora paler, femora and tibia without dusky bands. Spine formulae: Tibiae I: v2.2.2; II: v2.2.2; III-IV: v2.2; metatarsi I–IV: v2.2. Femora I–IV: d1.1.1.

Measurements. Total length: 11.13, prosoma: 5.30 long, 5.60. Diameter of eyes: AME 0.36, ALE 0.20, PME 0.38, PLE 0.45. Leg lengths: I: femur 5.95/ patella 2.80/ tibia 5.40/ metatarsus 5.30/ tarsus 2.35/ total 21.80; II: 6.90/ 2.80/ 6.50/ 5.85/ 2.40/ 24.45. III: 6.95/ 2.50/ 6.25/ 5.75/ 2.25/ 23.70; IV: 6.70/ 2.30/ 5.60/ 5.60/ 2.23/ 22.43. Formula: 2341.

Female (Paratype): Coloration similar to the male (Fig. 9).

Epigynum. Wider than long, triangular (Fig. 10). Spermathecae oval, with a triangular trasparent membrane that covers them (Fig. 11).

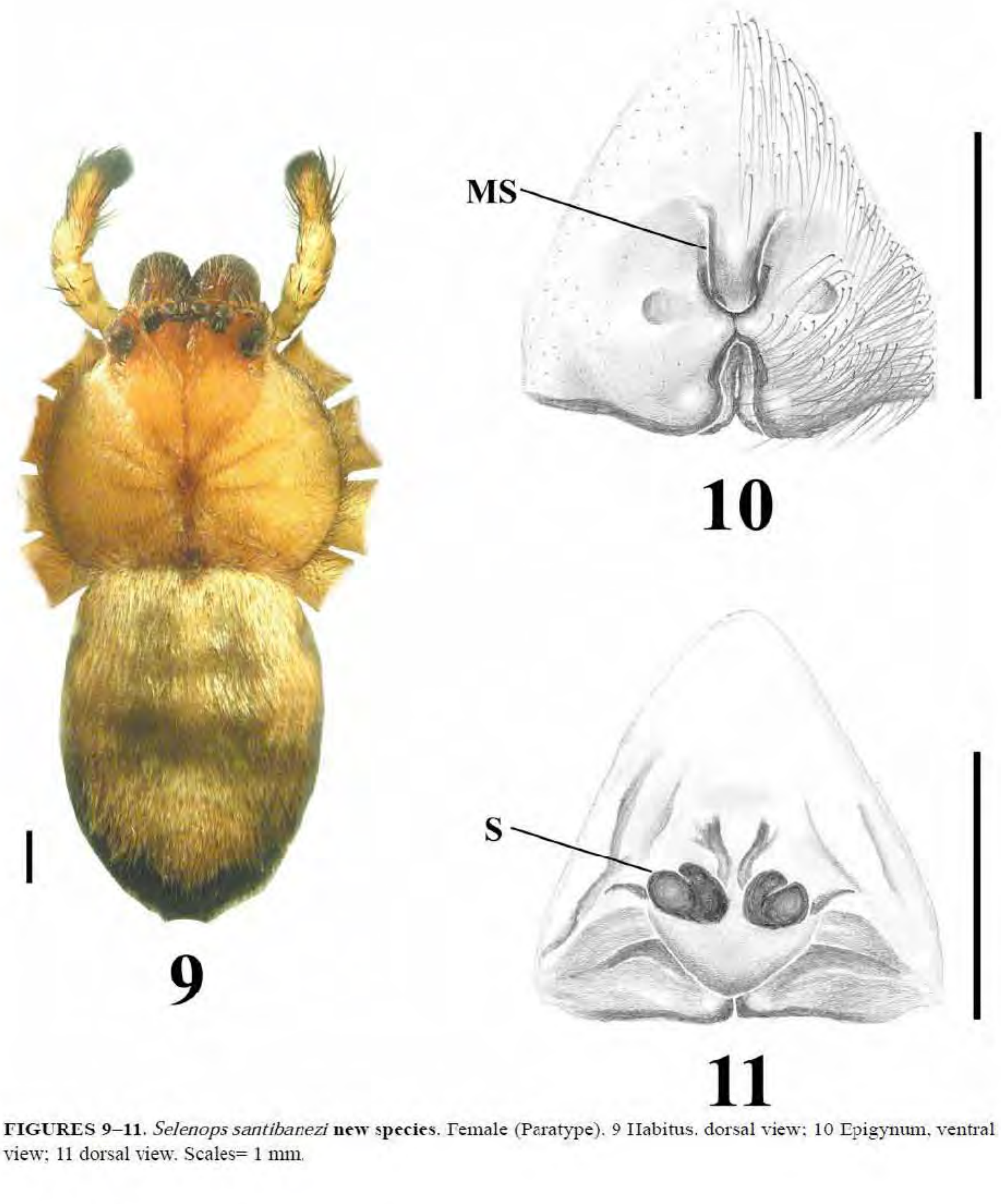
Measurements. Total length (prosoma + opisthosoma): 12.0, prosoma: 5.35 long, 5.5 wide. Diameter of eyes: AME 0.36, ALE 0.2, PME 0.38, PLE 0.44. Leg lengths: I: femur 4.85/ patella 2.45/ tibia 4.27/ metatarsus 3.57/ tarsus 1.83/ total 16.97; II: 5.65/ 2.62/ 4.85/ 4.05/ 1.8/ 18.97; III: 5.75/ 2.35/ 4.55/ 4.0/ 1.73/ 18.38; IV: 5.4/ 2.1/ 4.35/ 3.95/ 1.83/ 17.63.

Distribution. Only known from Santa Catarina Ixtepeji in Oaxaca state, Mexico. (Fig. 20).

Natural history. The specimens were collected on bromeliads between the bracts, approximately 3 meters above the ground. These spiders have very fast movements, escaping between the bracts, rendering their capture quite difficult. The bromeliads were growing on oaks (*Quercus* sp.) (Fig. 19), in deciduous forest, near 2000 meters elevation, in the Northern Sierra Madre, Oaxaca State.

Remarks. Following Muma (1953), *Selenops santibanezi* belongs to the *lindborgi* group by having the leg formula 2341, by having RTA broad and distally twisted, female epigynum with auxiliary concavities and with spermathecal openings widely separated, and by having spine formulae: tibiae I–II: v2.2.2, metatarsi I–II: v2.2. Two species belong to *lindborgi* species group: *S. lindborgi* Petrunkevitch, 1926 and *S. formosus* Bryant, 1940. One South American species, *S. hebraicus* Mello-Leitão, 1945 also seems to belong here (Muma 1953).

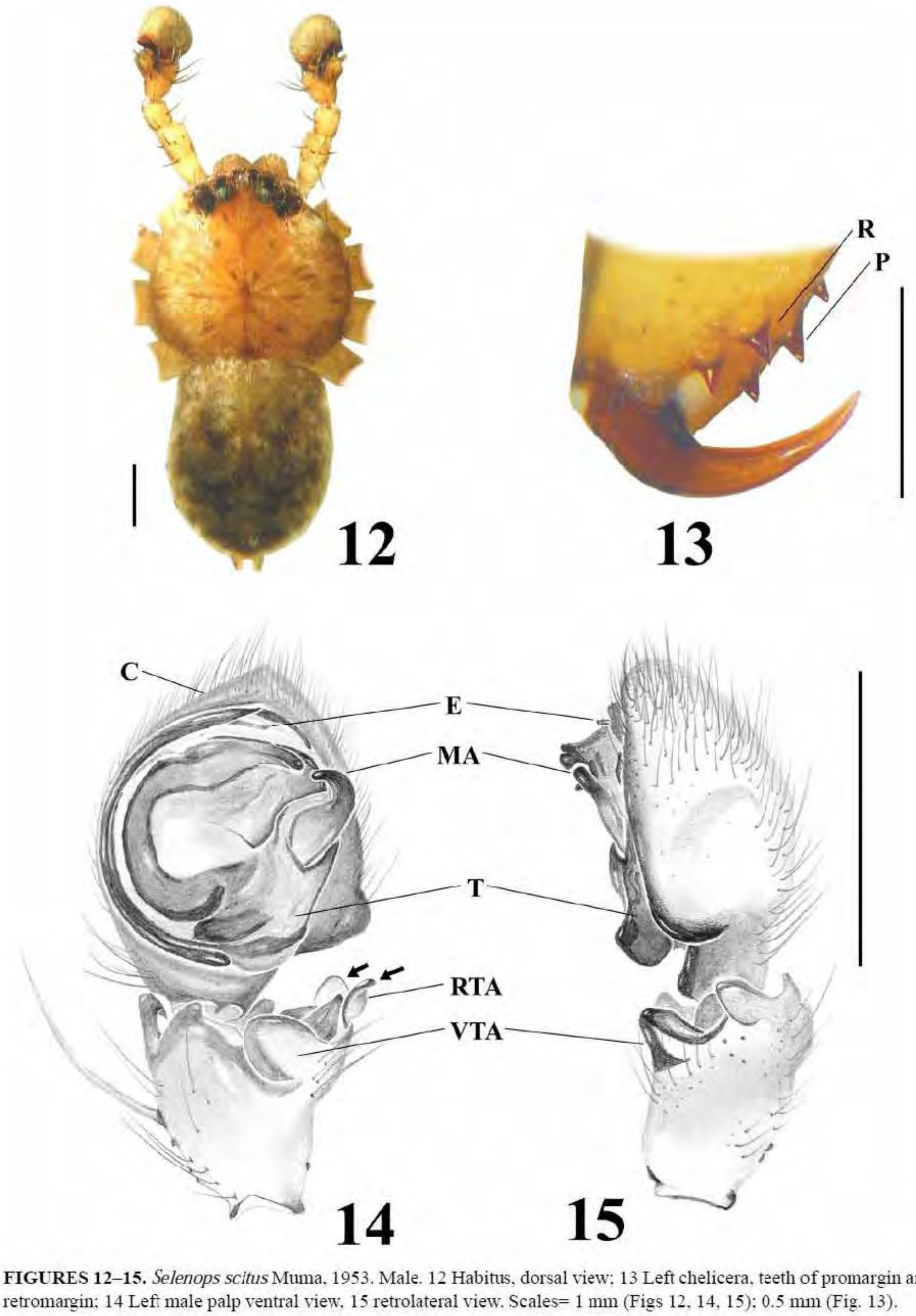
Selenops santibanezi new species resembles to *Selenops lindborgi* Petrunkevitch, 1926 by the shape of the RTA and VTA, but in the new species the RTA is wider distally than in *S. lindborgi*, and in retrolateral view the new species has axe-shaped RTA whereas *S. lindborgi* has triangular-shape; in addition the MA in *S. lindborgi* is more extended than in *S. santibanezi* and closer to basal than to distal part of cymbium compared to *S. santibanezi*. The female epigynum of the new species has a vertical median septum of the epigynum in contrast to *S. lindborgi*, which has epigynum divided into two oval, diagonal, elevated areas, with posterior margin with a deep, narrow, median notch.



FIGURES 9–11. *Selenops santibanezi* **new species.** Female (Paratype). 9 Habitus, dorsal view; 10 Epigynum, ventral view; 11 dorsal view. Scales= 1 mm.

Selenops scitus **Muma, 1953**
S. scitus Muma, 1953: 19, f. 32 (Description ♀).
Figures 12–18

Type material: Female holotype (not examined) from Mexcala [*sic*], [Guerrero, Mexico], August 1946, C. J. Goodnight, deposited in the American Museum of Natural History, New York.



FIGURES 12–15. *Selenops scitus* Muma, 1953. Male. 12 Habitus, dorsal view; 13 Left chelicera, teeth of promargin and retromargin; 14 Left male palp ventral view, 15 retrolateral view. Scales= 1 mm (Figs 12, 14, 15); 0.5 mm (Fig. 13).

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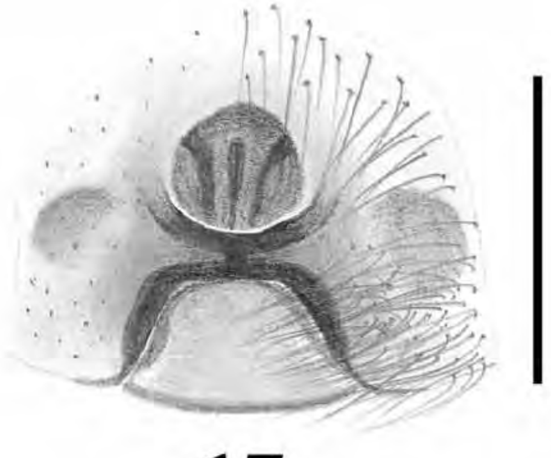

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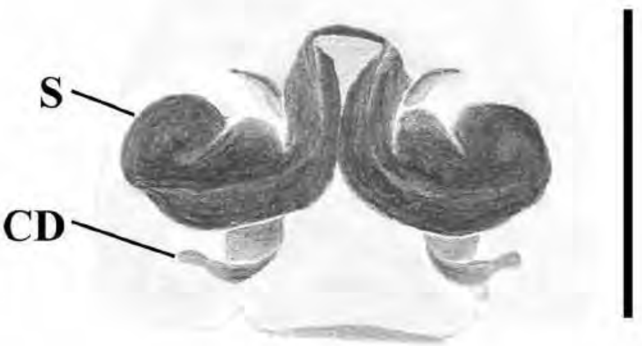

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FIGURES 16–18. *Selenops scitus* Muma, 1953. Female. 16 Habitus, dorsal view; 17 Epigynum, ventral view; 18 dorsal view. Scales= 1 mm (Fig. 16); 0.5 mm (Figs. 17, 18).

Other material examined. Male and female from Cerro "La Víbora", in front of Santa Cruz (deciduous thorn scrub), [lat 18.18298333°, lon -99.1174°, 1011 m; Municipio Atenango del Río, Guerrero, México], 5 July 2000, F. Álvarez, E. González (CNAN 3223). Male and female from Atenango del Río (deciduous thorn scrub), [lat 18.1258°, lon -99.08988333°, 651 m; Municipio Atenango del Río, Guerrero, México], 14 June 2000, G. Montiel, F. Álvarez, E. González, O. Delgado, J. Castelo, E. Lira, C. Durán (CNAN 3224).

Diagnosis. Males can be distinguished by the oval shape of the VTA (Fig. 14). The RTA is short, bifurcated, the longer branch is claw-shaped, and the shorter one is oval (arrows in Fig. 14). The MA has only one hook-shaped projection (Figs 14, 15). Females can be distinguished by the shape of the epigynum, the median portion forming a subsquared concavity near the epigastric furrow; and by the circular portion in anterior part (Fig. 17).

FIGURE 19. Microhabitat of *Selenops santibanezi* new species, arrow show the area among the bracts where the specimens were collected. Probably it is the same microhabitat for *Selenops aztecus*.

Description. Male: Carapace brown, with dusky markings (Fig. 12). Ocular region with fine white setae. Clypeus shorter than AME, equivalent to ¾ of their diameter. Chelicerae pale orange, with a J-shaped dark gray central pattern and curving on prolateral portion. Promargin of the chelicerae with three teeth; middle tooth closer to basal than to distal tooth, the middle one is bigger; retromargin with two teeth, the basal is bigger (Fig. 13). Sternum round, and yellow. Labium brown, with two darker lateral notches basally; not fused to the sternum. Trapezoidal gnathocoxae pale brown, lighter distally. Opisthosoma gray dorsally, venter lighter. ALS and PLS gray retrolaterally.

Palps. RTA conical, bifurcated distally, shorter than tibia (Figs 14, 15).

Legs. Pale orange, with two marked dusky bands on each segment, except on patellae and tarsi. Spine formula: Tibiae I–II: v2.2.2, III-IV: v2.2; metatarsi I–II: v2.2, III–IV: v2.1. Femora I–IV: d1.1.1.

Measurements. Total length: 6.4, prosoma: 3.2 long, 3.3 wide. Diameter of eyes: AME 0.21, ALE 0.13, PME 0.28, PLE 0.35. Leg lengths: I: femur 3.52/ patella 1.45/ tibia 3.10/ metatarsus 3.00/ tarsus 1.78/ total 12.85; II: 3.95/ 1.45/ 3.37/ 3.17/ 1.86/ 13.80; III: 4.05/ 1.45/ 3.45/ 3.30/ 1.76/ 14.01; IV- 4.27/ 1.25/ 3.65/ 3.75/ 1.86/ 14.78. Formula: 4321.

Female: Coloration similar to the male (Fig. 16).

Epigynum. Wider than long, oval (Fig. 17). Spermathecae with two anterior oval protuberances; CD long and curved, oval distally (Fig. 18). Spine formula: Femora I–IV: d3.2.2. *Measurements:* Total length: 8.1, prosoma: 3.15 long, 3.2 wide. Diameter of eyes: AME 0.18, ALE 0.12, PME 0.28, PLE 0.34. Leg lengths: I: femur 3.05/ patella 1.43/ tibia 2.65/ metatarsus 2.25/ tarsus 1.36/ total 10.74; II: 3.52/ 1.46/ 2.87/ 2.5/ 1.4/ 11.75; III: 3.77/ 1.4/ 3.07/ 2.62/ 1.4/ 12.26; IV: 3.8/ 1.13/ 3.1/ 2.95/ 1.53/ 12.51.

Distribution. Known from several localities in the Mexican state Guerrero: Mezcala, Santa Cruz, Atenango del Río (Fig. 20).

FIGURE 20. Records of *Selenops aztecus* new species (▲); *Selenops santibanezi* new species (●); and *Selenops scitus* Muma, 1953 (♦).

Remarks. Following Muma (1953), *Selenops scitus* Muma, 1953 belongs to the *debilis* group by having the leg formula 4321; by having spine formulae: tibiae I and II: v2.2.2, metatarsi I and II: v2.2; palp of the male by having RTA bifurcated; MA of palp with only one hook-shaped projection, located at the middle or in the distal half near the retrolateral margin; by having the embolus long and slender, extending at least one-third of the distance around the cymbium; by the median subquadrate guide in the epigynum of the female; and by the spermathecal openings located near the epigastric furrow.

Selenops scitus resembles *Selenops debilis* Banks, 1898 in the shape of the palps and epigynum, but in *S. scitus* the RTA of the palp is shorter than in *S. debilis*, furthermore the RTA is bifurcated in *S. scitus* and in *S. debilis* it is simple. The VTA in *S. scitus* is oval and wide, in *S. debilis* is shorter. The MA in *S. scitus* is wider than in *S. debilis*, in *S. scitus* it is situated in the median part of cymbium, whereas in *S. debilis* it is near to distal part. The epigynum in *S. debilis* has a vertical and thin median septum that *S. scitus* does not have; and *S. scitus* has a subsquared concavity near to the epigastric furrow that is lacking in *S. debilis*

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Four new species of the genus *Pseudocellus* (Arachnida: Ricinulei: Ricinoididae) from Mexico

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Four new species of the genus *Pseudocellus* (Arachnida: Ricinulei: Ricinoididae) from Mexico

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Abstract. Four new species of ricinuleids are described: *Pseudocellus chankin* from caves and surface collections in southern Mexico (Chiapas & Tabasco) and Guatemala (Petén); *Pseudocellus jarocho* from a single surface collection in Veracruz, México; *Pseudocellus oztotl*, a troglobitic and troglomorphic species from Cueva de Las Tres Quimeras in the Sierra Negra, Puebla, Mexico; and *Pseudocellus platnicki*, also troglobitic and troglomorphic, known from a single cave in Coahuila, Mexico. The number of known species in the genus increases to 24, and Mexican species to 14. An identification key for adult males of the species found in Mexico and southern USA is provided.

Keywords: Biodiversity, troglobites, troglomorphism, caves

The order Ricinulei is currently the smallest of Arachnida with two suborders: Paleoricinulei Selden 1992 with two families (Curculioididae Cockerell 1916 and Poliochericlae Scudder 1884), four genera and 16 fossil species; and Neoricinulei Selden 1992 with only one family (Ricinoididae Ewing 1929), three genera and 68 living species (Selden 1992; Harvey 2002, 2003; Botero-Trujillo & Pérez 2009; Tourinho & Azevedo 2007; Tourinho & Saturnino 2010; Tourinho et al. 2010). The three ricinoidid genera have distinct distributions in the world: the genus *Ricinoides* Ewing 1929 with 11 species is distributed in equatorial west and central Africa (Harvey 2003; Naskrecki 2008; Cokendolpher & Enríquez 2004; Botero-Trujillo & Pérez 2009); *Cryptocellus* Westwood 1874, with 35 species is known from Honduras southward through Central and tropical South America to Brazil (Bonaldo & Pinto-da-Rocha 2003; Harvey 2003; Pinto-da-Rocha & Bonaldo 2007; Tourinho & Azevedo 2007; Botero-Trujillo & Pérez 2008, 2009; Platnick & García 2008); and the genus *Pseudocellus* Platnick 1980, with 20 named species is distributed in North America (USA and Mexico), Cuba and Central America (Guatemala to Panama) (Gertsch & Mulaik 1939; Bolívar & Pieltain 1946; Gertsch 1971; Platnick & Pass 1982; Harvey 2003; Cokendolpher & Enríquez 2004; Teruel & Armas 2008).

Mexico has the highest diversity of ricinuleids in the world. Ten species of *Pseudocellus* are known from Mexico, not considering the four new species described in this work: *P. bolivari* (Gertsch 1971); *P. boneti* (Bolívar & Pieltain 1942); *P. gertschi* (Márquez & Conconi 1974); *P. mitchelli* Gertsch 1971; *P. osorioi* (Bolívar & Pieltain 1946); *P. pearsei* (Chamberlin & Ivie 1938); *P. pelaezi* (Coronado-Gutierrez 1970); *P. reddelli* (Gertsch 1971); *P. sbordonii* (Brignoli 1974); and *P. spinotibialis* (Goodnight & Goodnight 1952).

Ricinuleids are generally found in leaf litter and in the soil, under rocks and logs; and many of the species in the genus *Pseudocellus* inhabit caves (Cokendolpher & Enríquez 2004). Our knowledge of *Pseudocellus* in general is still very fragmentary because most of the species were originally described on the basis of few specimens or from single individuals; with few species known from male, female and immature stages (Pittard & Mitchell 1972; Platnick & Pass 1982; Cokendolpher & Enríquez 2004).

In this work four new Mexican species of *Pseudocellus* are described from the states of Chiapas, Coahuila, Puebla, and Veracruz. Two are known only from caves and are highly troglomorphic; one is known from both the surface and from two caves and shows no troglomorphisms, and the last one is known only from one location, collected under a large boulder in a pine forest, and does not have any troglomorphisms.

METHODS

The specimens, preserved in 80% ethanol, were examined and measured with a Nikon SMZ645 stereoscope. The measurements, given in mm, were made following Cooke and Shadab (1973). We named the segments of the legs following Gertsch (1971), Pittard & Mitchell (1972), and Platnick & Pass (1980) to facilitate cross-referencing. The names of copulatory structures follow Pittard & Mitchell (1972). Brief descriptions and complete measurements are provided for immature stages when available.

Dissecting microscopes (Zeiss Stemi SV11 and Nikon SMZ 800) fitted with a camera lucida were used to make the drawings. The tarsal processes and spermathecae were suspended in 96% gel alcohol (to permit proper positioning) and then covered with a thin layer of liquid ethanol (80%) to minimize diffraction during observation and drawing. The photographs of living specimens were taken with a Nikon Coolpix E4600 camera. The map was prepared with ArcView GIS Version 3.2 (Applegate 1999). Illustrations were edited with Adobe Photoshop 7.0.

The specimens are deposited primarily in the Colección Nacional de Arácnidos (CNAN) of the Instituto de Biología, Universidad Nacional Autonoma de México, Mexico City (IBUNAM); but some are in the Colección de Arácnidos de El Colegio de la Frontera Sur (ECOSUR-ECOTAAR), Tapachula, Chiapas, México; and in the Invertebrate Zoological Collection of the Texas Memorial Museum (TMM-IZC), University of Texas, Austin. Specimens used for comparative purposes and the elaboration of the key are listed in Appendix 1. For species not included in that list, the information was obtained from the literature, primarily from the original descriptions.

Abbreviations used in the figures are: AP, accessory piece of tarsal process; LT, lamina cyathiformis of tarsomere 2; MTP, metatarsal process; S, spermathecae; TP, tarsal process.

TAXONOMY

Family Ricinoididae Ewing 1929
Genus *Pseudocellus* Platnick 1980

Pseudocellus Platnick 1980:352.

Type species.—*Cryptocellus dorotheae* Gertsch & Mulaik 1939, by original designation.

KEY TO ADULT MALES OF *PSEUDOCELLUS* SPECIES FROM MEXICO AND USA

1. Troglomorphic species with all appendages elongated (Figs. 17, 24); femur II at least 1.5× longer than carapace; tibia II longer than carapace 2
   Edaphomophic species with short appendages (Figs. 1, 10): femur II less than 1.5× carapace length; tibia II shorter than carapace 8
2. Femur II length/width ratio greater than 9; femur II over twice as long as carapace 3
   Femur II length/width ratio less than 9; femur II less than 2 × carapace length 6
3. Cheliceral fingers with 5 teeth . . . . . *P. reddelli*
   Cheliceral fingers with more than 5 teeth 4
4. Leg formula 2413; tibia II twice as long as patella II . . . . . *P. sbordonii*
   Leg formula 2431; tibia II less than two times patella length 5
5. Tibia I with a granulose prolateral hump (Figs. 24, 26); tibia II and tarsus II unarmed; body and appendages evenly, finely pitted . . . . . *P. platnicki* new species
   Tibia I without a granulose prolateral hump (Fig. 17); tibia II (Fig. 19) and tarsus II with two distinct rows of spines prodorsally and proventrally; body and appendages finely pitted . . . . . *P. oztotl* new species
6. Leg formula 2341; cheliceral fixed finger with 4 teeth; tarsal claws asymmetrical, some spatulate . . . . . *P. bolivari*
   Leg formula 2431; cheliceral fixed finger with 6 teeth; tarsal claws symmetrical, none spatulate 7
7. Tibia II elongated, about 11× longer than wide, with few scattered spines prolaterally; cheliceral movable finger with teeth uniform in size . . . . . *P. osorioi*
   Tibia II shorter, about 6× longer than wide, with two distinct rows of spines prolaterally; cheliceral movable finger with basal tooth distinctly larger than the rest . . . . . *P. boneti*
8. Tibia II armed with one or two distinct tubercles prolaterally 9
   Tibia II without distinct tubercles prolaterally 11
9. Femur II moderately thickened, 4× longer than wide; tibia II with a single prodorsal tubercle, lacking a distinct proventral tubercle . . . . . *P. pearsei*
   Femur strongly thickened, less than 2.5× longer than wide; tibia II prodorsal and proventral tubercles subequal in size . . 10
10. Femur II shorter than carapace; tibia II with prodorsal and proventral tubercles aligned, medial . . . . . *P. spinotibialis*
    Femur II distinctly longer than carapace; tibia II with tubercles not aligned, proventral on basal one-third, and prodorsal on distal one-third (Figs. 1, 3) . . . . . *P. chankin* new species
11. Leg formula 2431; carapace and opisthosoma distinctly and evenly pitted 12
    Leg formula 2341; integument not distinctly pitted 13
12. Adult 3.2 mm in total length; tibia II slightly over 0.5× carapace length; patella II and tibia II subequal in length . . . *P. dorotheae*
    Adult 5.0 mm in total length; tibia II almost equal to carapace length; tibia II 1.5× longer than patella II . . . . . *P. mitchelli*
13. Femora I and IV conspicuously enlarged, at least 1.5× thicker than preceding and following segments . . . . . *P. gertschi*
    Femora I and IV not enlarged, about same thickness as preceding and following segments 14
14. Femur II thickened, 2.5× longer than wide; tibia II 1.5× or more the length of patella II . . . . . *P. pelaezi*
    Femur II not thickened, slightly over 4× longer than wide; tibia II 1.2× longer than patella II . . . . . *P. jarocho* new species

Pseudocellus chankin new species
Figs. 1–9

Pseudocellus sp. n. 2: Cokendolpher & Enriquez 2004:99.

Type material.—MEXICO: *Chiapas*: holotype male, Cueva Kolem-chen "Cueva Grande," Reserva Chan-kin, Municipio Ocosingo (16.691389°N, 90.824028°W, 144 m), 10 August 2006, A. Valdez, H. Montaño, S. Rubio, N. Pérez, I. Mondragón (CNAN-T0263). Paratypes: 1 female, same locality as holotype, 19 October 2006, A. Valdez, H. Montaño, O. Francke, A. Ballesteros (CNAN-T0280); 1 female, Hidalgo Cortés, orillas de la Reserva Montes Azules, Municipio Ocosingo (16.689194°N, 90.930167°W, 150 m), 11 August 2006, A. Valdez, H. Montaño, S. Rubio, N. Pérez, I. Mondragón (CNAN-T0281); 2 females, same locality as holotype, 7 November 2006, A. Valdez, H. Montaño, R. Paredes, G. Montiel, F. Bertoni (CNAN-T0282).

Other specimens examined.—MEXICO: *Chiapas*: 2 deutonymphs, 4 tritonymphs, same data as holotype (CNAN-Ri0001); 2 ♀♀, 1 larva, 1 tritonymph, same locality as holotype, 7 November 2006, A. Valdez, H. Montaño, R. Paredes, G. Montiel, F. Bertoni (CNAN-Ri0020). *Tabasco*: 2 ♂♂, 1 ♀, 2 larvae, Parque Estatal Agua Blanca, Ejido Las Palomas Municipio Macuspana (17.62126°N, 92.47928°W, 124 m), 12 July 2010, O. Francke, J. Cruz-López, C. Santibáñez, G. Montiel, D. Barrales, G. Contreras (CNAN-Ri0021). GUATEMALA: *Petén*: 2 ♂♂, 1 larva, 1 protonymph, Cueva del Río Murciélagos, Dos Pilas, Sayaxche, 25 March 1993, A. Cobb, B. Luke (TMM-IZC #3,288); 2 ♀♀, Kaxon Pec (Cave), Dos Pilas, Sayaxche, May 1993, A. Cobb (TMM-IZC #3,287).

Etymology. The specific name is a noun in apposition and refers to the name of the biological reserve that includes the type locality, Reserva Chan-kin.

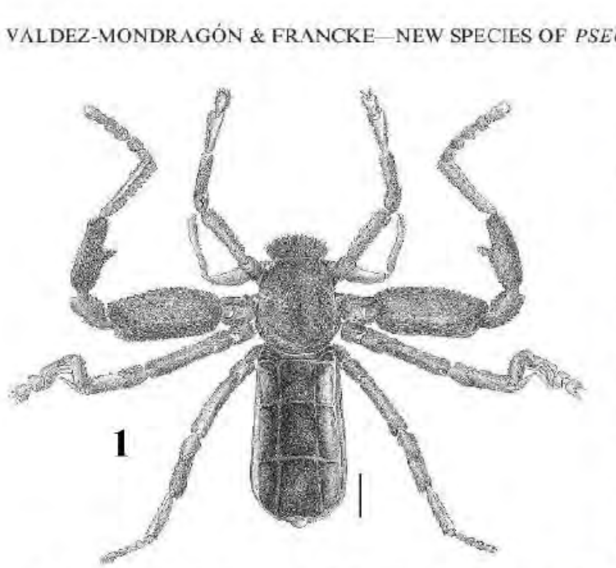

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Figure 1.—*Pseudocellus chankin* new species. Male holotype. Habitus, dorsal view. Scale = 1 mm.

Diagnosis.—Males can be distinguished by the presence of two strong tubercles on tibia II, one prodorsal and the other proventral (Figs. 1, 3); by the very robust femur II (Fig. 1), 2.4 times longer than wide; by having the tarsal process curved, J-shaped (Figs. 4, 5) and the accessory piece of tarsal process of leg III (displaced position) thin, slightly curved and bifurcated distally (Fig. 5); metatarsal process conical, curved distally (Fig. 4), and cucullus trapezoidal (Fig. 2). Females can be distinguished by the curved and bifurcate spermathecae (Figs. 6, 7).

Description.—*Male (holotype):* Carapace: Slightly longer than wide, wider in posterior part near coxae III. Covered uniformly with numerous and fine translucent setae; and numerous rounded granules, more visible on marginal pale areas, located on median part, corresponding to ocular areas, between coxae I and II (Fig. 1). Dorsal depressions near to pale marginal areas, and slight depressions on posterior and median parts.

Cucullus: Wider than long, notably wider distally, with numerous rounded granules larger than those on carapace. Densely covered with long, fine translucent setae, especially on distal part, where they are also longer (Fig. 1).

Chelicerae: Fixed finger shorter than movable; fixed finger with six teeth, the distal longer and the basal one shorter; movable finger with six teeth, the basal one longer, distally decreasing in size.

Sternal region: Coxae I meeting the tritosternum in a single point; coxae II meeting it along anterior third, coxae II considerably longer than others.

Pedipalps: Trochanters 1 and 2 with few rounded granules ventrally. Femora curved distally; with few, small basal granules retrolatero-ventrally. Tibiae with granules distally on dorsal and ventral surfaces. All segments densely covered with translucent, small setae, uniform in size (Fig. 1).

Legs: Femora I–IV with numerous sharp-tipped granules ventrally, with femur II having the most. Tibiae I–II with large granules ventrally; including those on the two strong tubercles of tibiae II (Fig. 1); tibiae III–IV with smaller granules than on I and II. Granules on metatarsi II larger than on metatarsi I. Metatarsi III-IV without granules.

Copulatory apparatus: Metatarsus short and wide, conical; tarsal process wider in distal half (Figs. 4, 5). Tarsomere 1 curved ventrally. Lamina cyathiformis of tarsomere 2 with slight notch basally; tarsomere 2 rectangular (Fig. 4).

Opisthosoma: Longer than wide, widest at posterior part, near tergite XIII (Fig. 1). Tergite XI as wide as long, tergites XII–XIII and lateral tergites longer than wide (Fig. 1). Lateral tergites in diagonal position, forming an ample concavity in median part (Fig. 1). Covered uniformly with numerous, small translucent setae both dorsally and ventrally, and without granules. Pygidium basal segment without notch on posterior dorsal and ventral margins.

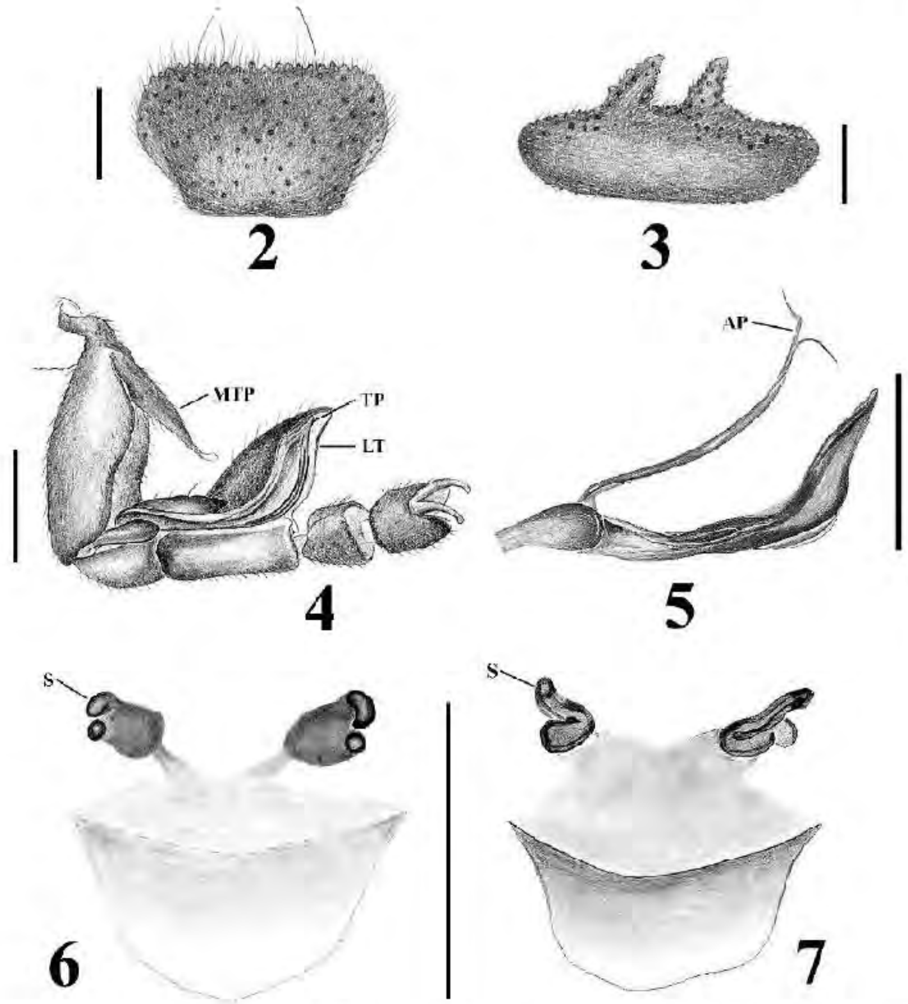
Coloration: Appendages and body reddish brown. Pedipalps lighter than other appendages; all appendages lighter red distally. Cucullus, carapace, opisthosoma and legs II dark reddish, legs II darker reddish than other appendages. Opisthosoma ventrally with dark region covering ¾ of its length.

Measurements: Total length (carapace + opisthosoma + pygidium) 6.15. Carapace 2.10 long, 1.95 wide (widest part). Cucullus 0.87 long, 1.42 wide. Opisthosoma 4.25 long, 2.20 wide (widest part). Robustness of leg II, ratio of male femur II: length / diameter (widest part) (femur II l/d): 2.37. Legs tarsal formula (legs I–IV): 1-5-4-5. Leg lengths, I: coxa 0.86/ trochanter 1 0.56/ trochanter 2 -/ femur 1.58/ patella 0.75/ tibia 1.15/ metatarsus 1.28/ tarsus 0.62/ total 6.80; II: 1.16/ 0.87/ -/ 2.87/ 1.23/ 2.00/ 1.85/ 2.2/ 12.18; III: 0.92/ 0.60/ 0.62/ 1.52/ 0.80/ 0.98/ 1.10/ 1.60/ 8.14; IV: 0.81/ 0.63/ 0.58/ 1.73/ 0.80/ 1.12/ 1.13/ 1.33/ 8.13; Pedipalp: 0.7/ 0.8/ 0.45/ 1.13/ -/ 1.60/ -/ 0.14/ 4.82. Leg formula: 2341.

Variation (n = 5): One male from Petén dark red, holotype and the other male from Petén lighter in color. Males from Tabasco lighter red than the others. Granules larger and more visible on males from Petén and Tabasco than on the other two males, especially on all segments of leg II. Movable finger of chelicerae with six teeth on the holotype, on one male from Petén and on one male from Tabasco; seven teeth on the other male from Petén; and five teeth on the other male from Tabasco. The two ventral tubercles on tibia II thinner and smaller on one male from Petén and males from Tabasco than on the other two males. Total length: 6.15–6.80 ($\bar{x}$ = 6.40 ± 0.32), Cucullus: width 1.45–1.60 ($\bar{x}$ = 1.56 ± 0.10), Carapace: width 1.95–2.10 ($\bar{x}$ = 2.00 ± 0.07), Opisthosoma: length 4.25–5.00 ($\bar{x}$ = 4.50 ± 0.38), width 2.20–2.45 ($\bar{x}$ = 2.35 ± 0.13). Femur II l/d: 2.27–2.80 ($\bar{x}$ = 2.53 ± 0.21).

Female (paratype). Differs from male as follows: Femur II not as robust, 3.7 times longer than wide. Left fixed finger of chelicerae with four teeth, right with five teeth. Femora I-IV with fewer and smaller ventral sharp-tipped granules than the male. Tibiae II with the two prolateral tubercles smaller than on the male. Tibiae III–IV with fewer granules. Opisthosoma wider than on the male. Tergite XI wider than long. Tergite XII as wide as long. Opisthosoma ventrally with two dark thin depressions, on sternites XI, XII and XIII.

Measurements: Total length 6.35. Carapace length 2.15, width 2.10 (widest part). Cucullus length 0.90, width 1.47. Opisthosoma length 4.50, width 2.75 (widest part). Femur II l/d: 3.50. Legs tarsal formula (legs I–IV): 1-5-4-5. Leg lengths, I:

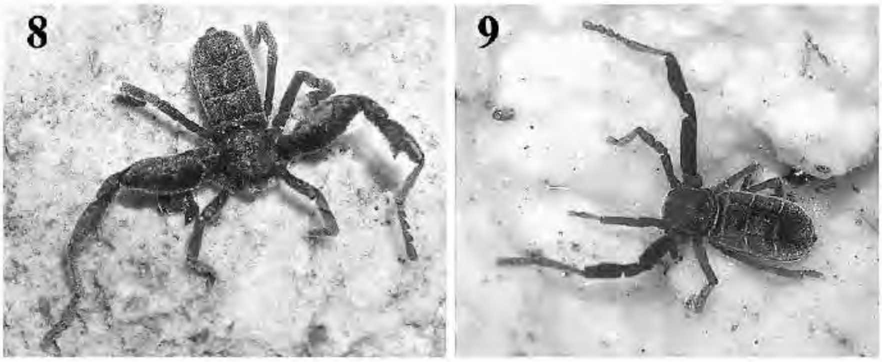


Figures 2–7.—*Pseudocellus chankin* new species. Male holotype. 2. Cucullus, dorsal view; 3. Left tibia II, ventral view; 4. Left leg III, metatarsus and tarsal process, prolateral view; 5. Tarsal process (displaced position), prolateral view. Female paratype. Spermathecae; 6. Anterior view; 7. Posterior view. Scales = 0.5 mm.

coxae 0.92/ trochanter 1 0.50/ trochanter 2 -/ femur 1.45/ patella 0.70/ tibia 1.05/ metatarsus 1.23/ tarsus 0.66/ total 6.51; II: 1.15/ 0.77/ -/ 2.57/ 1.05/ 1.80/ 1.87/ 2.12/ 11.33; III: 0.93/ 0.53/ 0.66/ 1.58/ 0.78/ 1.00/ 1.10/ 1.00/ 7.58; IV: 0.86/ 0.55/ 0.56/ 1.71/ 0.72/ 1.10/ 1.15/ 1.10/ 7.75; Pedipalp: 0.75/0.38/ 0.46/ 1.12/ -/ 1.65/ -/ 0.16/ 4.52. Leg formula: 2431.

Variation ($n = 7$): Five females are dark reddish (two from Chiapas, two from Petén, and the female from Tabasco), and the other two females from Chiapas are lighter. Body granulation more conspicuous on lighter specimens. Chelicerae with a variable number of teeth, females from Chiapas: 1) fixed finger 4/ movable finger 6; 2) 6/8; 3) 5/7; 4) 5/6; females from Petén: 1) 5/6; 2) 5/7. Total length: 6.00–7.15 ($\bar{x} = 6.45 \pm 0.43$), Cucullus: width 1.42–1.67 ($\bar{x} = 1.54 \pm 0.10$), Carapace: width 1.95–2.25 ($x = 2.09 \pm 0.11$), Opisthosoma: length 4.15–4.90 ($\bar{x} = 4.45 \pm 0.30$), width 2.60–2.95 ($\bar{x} = 2.72 \pm 0.13$). Femur II l/d: 3.50–3.86 ($\bar{x} = 3.72 \pm 0.15$).

Larva: Carapace wider than long, with numerous small rounded granules. Cucullus wider than long, with a small concavity distally, covered with numerous and fine translucent setae, longer distally. Legs with numerous small granules and abundant fine translucent setae. Opisthosoma slightly longer than wide, covered with numerous small rounded granules and translucent setae; tergites XI–XIII wider than long; sternites XI–XIII well visible and not fused in comparison with adults. Appendages and body coloration pale brown; paler in cucullus and carapace. Measurements: Total length 1.87. Carapace 0.86 long, 0.95 wide (widest part). Cucullus 0.40 long, 0.66 wide. Opisthosoma 1.28 long, 1.22 wide. Legs tarsal formula (legs I–III) (larva hexapod): 1-2-2. Variation: ($n = 4$). Total length 1.87–2.70 ($\bar{x} = 2.28 \pm 0.58$). Cucullus: width 0.65–0.66 ($x = 0.655 \pm 0.007$), Carapace: width 0.93–0.95 ($x = 0.94 \pm 0.01$), Opisthosoma: long 1.28–1.66 ($\bar{x} = 1.47 \pm 0.26$), wide 1.22–1.33 ($\bar{x} = 1.27 \pm 0.07$).



Figures 8–9.—*Pseudocellus chankin* new species. 8. Male holotype walking on the ground inside the cave; 9. Female paratype walking on a wall inside the cave. (Photos by Alejandro Valdez-Mondragón).

Protonymph: Carapace longer than wide. Carapace, cucullus, legs and opisthosoma covered with numerous rounded granules and translucent setae like the larva. Cucullus wider than long; with fine translucent setae longer distally, like the larva. Opisthosoma longer than wide, tergites XI–XIII wider than long; sternites XI–XIII visible like the larva, and not fused like on the adults. Appendages and body coloration brown, darker than the larva, but not as dark as adults. Measurements: Total length 3.25. Carapace 1.16 long, 1.13 wide (widest part). Cucullus 0.50 long, 0.77 wide. Opisthosoma 2.05 long, 1.60 wide. Legs tarsal formula (legs I–IV): 1-4-3-2.

Deutonymph: Carapace slightly longer than wide. Carapace, cucullus, legs and opisthosoma covered with numerous rounded granules and translucent setae like the previous life stages. Cucullus wider than longer; with fine translucent setae, longer distally, like the previous life stages. Opisthosoma longer than wide, tergites XI and XII wider than long, tergite XIII slightly longer than wide; sternites XI–XIII well visible and not fused in comparison to adults. Appendages and body coloration brown, opisthosoma brown darker than cucullus, carapace and appendages. Measurements: Total length 4.40. Carapace 1.37 long, 1.35 wide (widest part). Cucullus 0.61 long, 1.00 wide. Opisthosoma 2.80 long, 1.90 wide. Legs tarsal formula (legs I–IV): 1-5-4-4. Variation: ($n = 2$). One specimen with brown coloration paler than the other. Total length 4.40, 4.65 ($\bar{x} = 4.52$). Cucullus: width 1.00, 1.00 ($\bar{x} = 1.00$), Carapace: width 1.35, 1.40 ($\bar{x} = 1.37$), Opisthosoma long 2.80, 3.00 ($\bar{x} = 2.90$), wide 1.90, 2.10 ($\bar{x} = 2.00$).

Tritonymph: Carapace slightly longer than wide, with two dorsal depressions on median part (one on each side) and four on posterior part (two on each side). Carapace, cucullus, legs, and opisthosoma covered with numerous rounded granules and translucent setae as in the previous life stages. Cucullus wider than long, with numerous fine translucent setae, longer distally, as in previous stages. Opisthosoma longer than wide, tergites XI and XII wider than long, tergite XIII longer than wide; sternites XI–XIII well visible, not fused together in comparison with adults. Appendages and body orange-brown, paler than adults. Measurements: Total length 5.95. Carapace 1.70 long, 1.65 wide (widest part). Cucullus 0.75 long, 1.22 wide. Opisthosoma 3.90 long, 2.45 wide. Legs tarsal formula (legs I–IV): 1-5-4-5. Variation: ($n = 4$). Two specimens orange-brown coloration, the other two specimens lighter. Total length 5.35–5.95 ($\bar{x} = 5.66 \pm 0.24$). Cucullus: width 1.15–1.22 ($\bar{x} = 1.17 \pm 0.03$), Carapace: width 1.65–1.70 ($\bar{x} = 1.66 \pm 0.02$), Opisthosoma: long 3.75–3.90 ($\bar{x} = 3.85 \pm 0.07$), wide 2.45–2.55 ($\bar{x} = 2.50 \pm 0.05$).

Related species.—*Pseudocellus chankin* resembles *Pseudocellus seacus* Platnick & Pass 1982 from Finca Seacté, near Cobán, Alta Verapaz, Guatemala, by having the similar shape of the two large tubercles of tibia II, but on *P. chankin* these tubercles are larger than on *P. seacus*; on *P. seacus* both of these tubercles are aligned, on the basal one-third of the tibia, whereas on *P. chankin* they are offset; one is dorsomedian and the other one ventrodistal (Fig. 3). *Pseudocellus chankin* has very robust femur II, approximately 2.4 times longer than wide, whereas on *P. seacus* it is relatively thinner, "about three times as long as wide" (Platnick & Pass 1982:5). There is a considerable difference in size, the new species larger: the total length of male holotype of *P. chankin* is 6.15 mm, whereas the total length of the male of *P. seacus* is only 3.67 mm. In addition, the tarsal process of the copulatory apparatus on *P. seacus* is trifurcated distally, whereas on *P. chankin* it is wider distally and is conical-shaped with a single, blunt end (Figs. 4, 5); the accessory piece on *P. chankin* is bifurcated distally, whereas on *P. seacus* it is not. The metatarsal process in the new species is longer, about two-thirds the length of the metatarsus, whereas on *P. seacus* it is only about one-third the length of the metatarsus. Finally, the spermathecae are similar in both species, but on the new species they are thinner than on *P. seacus* (Figs. 6, 7).

Distribution.—This species is known from Chiapas and Tabasco in Mexico, and Petén in Guatemala (Fig. 31).

Natural history.—Specimens of *P. chankin* from Chiapas were collected at 144 m elev., deep inside the cave, except the female from Hidalgo Cortés which was collected under a rock in the tropical rainforest of the Reserva de Montes Azules. The specimens from the cave were collected approximately 50 m inside it, on the walls and under rocks, near bat guano (Figs. 8, 9). The cave had high humidity, ca 70%, and was fairly warm. The habitat outside the cave is tropical rainforest, in the Lacandona region located in eastern Chiapas, near the border with Guatemala.

Remarks.—Cokendolpher & Enríquez (2004) reported the specimens from Guatemala (see Other Specimens Examined,

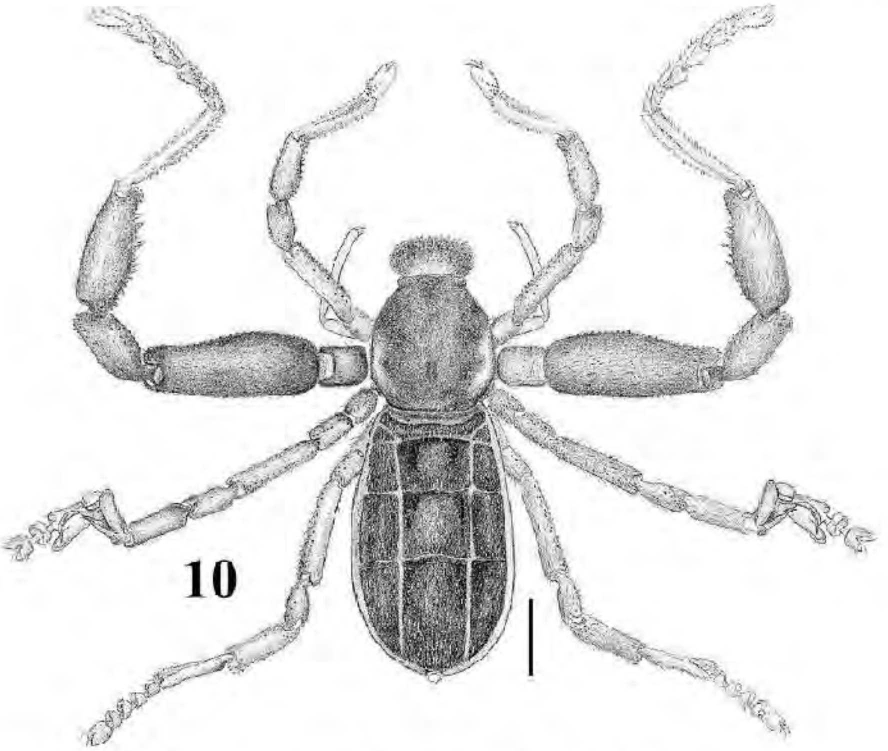


Figure 10.—*Pseudocellus jarocho* new species. Male holotype. Habitus, dorsal view. Scale = 1 mm.

above) as a new species of *Pseudocellus*, but the species was not described.

Pseudocellus jarocho new species
Figs. 10–16

Type material.—MEXICO: *Veracruz*: holotype male, 5 km E of Tlaquilpa (18.64103333°N, 97.10725°W, 2169 m), 24 March 2007, A. Valdez, O. Francke, H. Montaño, C. Santibáñez, A. Ballesteros, pine-oak forest (CNAN-T0627). Paratypes: 1 female (CNAN-T0628), 1 male, 2 females, 2 tritonymphs (CNAN-T0629), same data as holotype.

Etymology.—The specific name is a noun in apposition and refers to the common name given to people born in the state of Veracruz: Jarocho.

Diagnosis.—Males can be distinguished by the two ventral rows of curved spines on tibia II (Fig. 12); by having tarsal process with two tips distally, and the accessory piece of tarsal process of leg III (displaced position) bifurcated (Fig. 14); metatarsal process relatively long and curved (Fig. 13); and by the evenly oval shape of the cucullus (Fig. 11). Females can be distinguished by the double receptacle of the spermathecae in each side, and rounded distally (Figs. 15, 16).

Description.—*Male (holotype)*: Carapace: Slightly longer than wide, wider posteriorly, at level of coxae II and III. Covered with numerous, long, fine translucent setae; and numerous, small round granules, visible on ocular areas or marginal pale areas, located near coxae II (Fig. 10). Dorsal depression shallow, longitudinal, medial.

Cucullus: Wider than long, rounded laterally, with a slight notch distally. With numerous small, round granules; with moderately dense, fine and long translucent setae, especially on distal part where they are longer (Fig. 11).

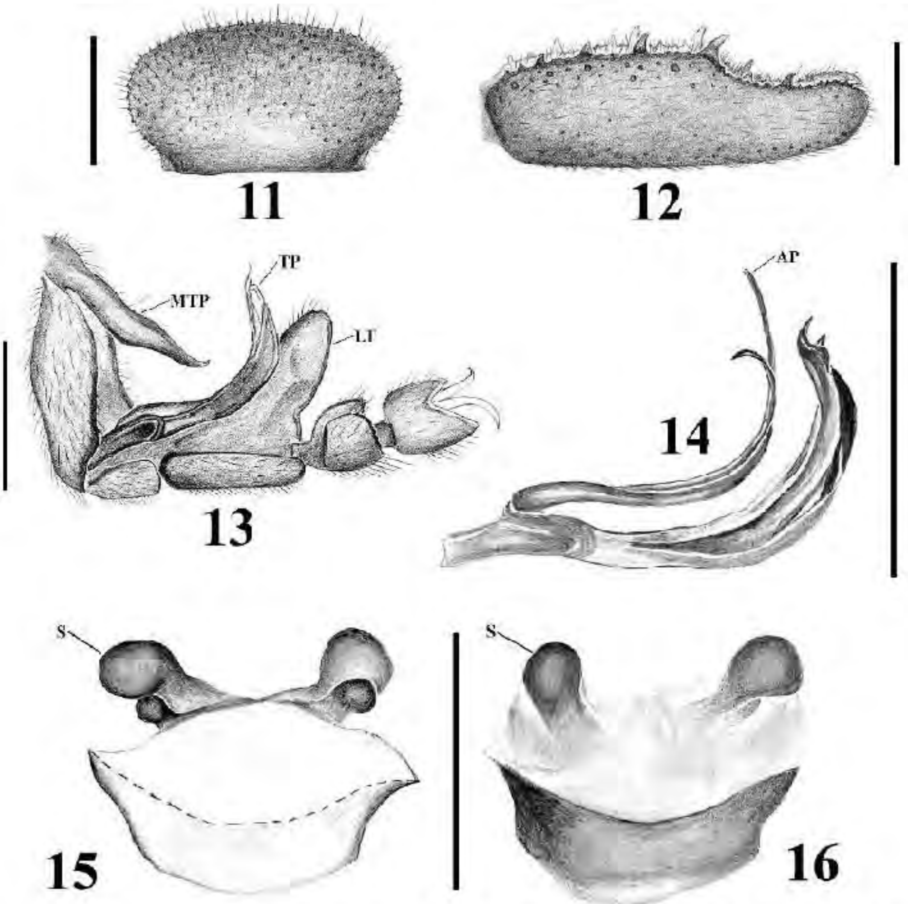
Chelicerae: Fixed finger shorter than movable, right fixed finger with six teeth, left with five, increasing in size distally. Both movable fingers with six teeth, basal-most longest.

Sternal region: Coxae I meeting the tritosternum in a single point; coxae II meeting it along anterior quarter, coxae II longer than others.

Pedipalps: Trochanters 1 and 2 with few ventral rounded granules. Femora curved distally; without granules; with fine, translucent setae, distally decreasing in size. Tibiae with rounded granules ventro-distally; with fine, translucent setae, mostly uniform in size but some longer ones distally.

Legs: Femora I, III and IV with two ventral rows of spines. Femur II with dispersed ventral spines. Tibia I with two ventral rows of small spines. Tibia II with two ventral rows of large spines (Fig. 12). Tibiae III–IV with few spines. Metatarsus I with two dorsal rows of spines, ventrally with dispersed granules. Metatarsus II with numerous prolateral, retrolateral, and ventral spines, and with two ventral rows of spines, shorter than on tibia II. Metatarsus IV distally with two dorsal rows with few spines, ventrally without granules.

Copulatory apparatus: Metatarsus short and wide, ventrally with one slight notch distally. Metatarsal process long and sigmoidal; tarsal process curved, widest at ¾ of its length (Fig. 13). Lamina cyathiformis of tarsomere 2 rounded



Figures 11–16.—*Pseudocellus jarocho* new species. Male holotype. 11. Cucullus, dorsal view; 12. Left tibia II, dorsal view; 13. Left leg III, metatarsus and tarsal process, prolateral view; 14. Tarsal process (displaced position), prolateral view. Female paratype. Spermathecae; 15. Anterior view; 16. Posterior view. Scales = 0.5 mm (Figs. 11–14), 0.3 mm (Figs. 15, 16).

distally, with slight notch basally; tarsomere 2 wider basally than distally (Fig. 13).

Opisthosoma: Longer than wide, widest at posterior part, between tergites XII and XIII (Fig. 10). Tergite XI wider than long, tergites XII XIII and lateral tergites longer than wide (Fig. 10). Lateral tergites inclined up and outwards, forming an ample concavity in median region (Fig. 10). Ventrally and dorsally covered uniformly with numerous fine, translucent setae. Tergites X–XIII with granules, vestigial on tergite XIII. Pygidium basal segment without notches posteriorly on dorsal and ventral margins.

Coloration: Body reddish-brown; pedipalps, legs I, III–IV dark brown, lighter distally. Cucullus, carapace, opisthosoma and legs II dark reddish. Opisthosoma dark ventrally.

Measurements: Total length (carapace + opisthosoma + pygidium) 5.15. Carapace 1.70 long, 1.60 wide (widest part). Cucullus 0.73 long, 1.15 wide. Opisthosoma 3.42 long, 2.05 wide (widest part). Femur II l/d: 2.58. Legs tarsal formula (legs I–IV): 1-5-4-5. Leg lengths, I: coxa 0.80/ trochanter 1 0.48/ trochanter 2 -/ femur 1.37/ patella 0.62/ tibia 1.00/ metatarsus 1.17/ tarsus 0.52/ total 5.96; II: 0.97/ 0.72/ -/ 2.27/ 1.10/ 1.67/ 1.62/ 1.90/ 10.25; III: 0.76/ 0.51/ 0.55/ 1.38/ 0.73/ 0.86/ 0.90/ 1.42/ 7.11; IV: 0.70/ 0.57/ 0.53/ 1.45/ 0.65/ 1.00/ 1.01/ 1.07/ 6.98. Pedipalp: 0.55/ 0.32/ 0.30/ 0.93/ -/ 1.37/ -/ 0.15/ 3.62. Leg formula: 2341.

Variation: (n = 2). Paratype male reddish-brown, darker than holotype. Granules on body and legs more developed on holotype than on paratype. Movable finger of chelicerae with six teeth on holotype, five teeth on paratype. The number of long spines on the two ventral rows on tibia II variable but similar in shape on both males. The number of spines on the two ventral rows on metatarsus II variable and longer on the holotype than on the paratype. Total length: 5.10, 5.15 ($\bar{x}$ = 5.12), Cucullus: width 1.13, 1.15 ($\bar{x}$ = 1.14), Carapace: width 1.55, 1.60 ($\bar{x}$ = 1.57), Opisthosoma: length 3.37, 3.42 ($\bar{x}$ = 3.39), width 1.92, 2.05 ($\bar{x}$ = 1.98), Femur II l/d: 2.58, 3.14 ($\bar{x}$ = 2.86).

Female (paratype). Differs from male as follows: Cheliceral right fixed finger with six teeth, left with nine teeth. Femur II with dispersed ventral spine-shaped granules, faint. Tibia II with two ventral rows of spines smaller than on the male.

Metatarsus I with ventral dispersed granules, only basally. Numerous prolateral, retrolateral, and ventral spine-shaped granules, and the two ventral rows of spines of metatarsus II smaller than the male. Opisthosoma ventrally lighter than on the male.

Measurements: Total length 5.40. Carapace 1.72 long, 1.70 wide (widest part). Cucullus 0.73 long, 1.20 wide. Opisthosoma 3.70 long, 2.20 wide (widest part). Femur II l/d: 4.10. Legs tarsal formula (legs I–IV): 1-5-4-5. Leg lengths, I: coxa 0.75/ trochanter I 0.46/ trochanter II -/ femur 1.28/ patella 0.60/ tibia 0.93/ metatarsus 1.16/ tarsus 0.53/ total 5.71; II: 1.00/ 0.71/ -/ 2.05/ 0.96/ 1.60/ 1.63/ 1.83/ 9.78; III: 0.85/ 0.50/ 0.50/ 1.35/ 0.68/ 0.98/ 1.00/ 0.90/ 6.76; IV: 0.73/ 0.58/ 0.53/ 1.41/ 0.67/ 1.06/ 1.05/ 1.02/ 7.05; Pedipalp: 0.62/0.38/ 0.42/ 1.02/ -/ 1.51/ -/ 0.15/ 4.10. Leg formula: 2431.

Variation: ($n = 2$). One female reddish, darker than the other one. Granules more prominent on lighter female. Variable number of ventral spine-shaped tubercles on femur II. Variable number and size of spines on ventral rows of tibia and metatarsus II. Total length: 5.25, 5.40 ($\bar{x}$ = 5.32), Cucullus: width 1.15, 1.20 ($\bar{x}$ = 1.17), Carapace: width 1.62, 1.70 ($\bar{x}$ = 1.66), Opisthosoma: length 3.60, 3.70 ($\bar{x}$ = 3.65), width 2.10, 2.20 ($\bar{x}$ = 2.15). Femur II l/d: 4.10, 4.60 ($\bar{x}$ = 4.35).

Tritonymph: Carapace as long as wide, with two inconspicuous dorsal depressions on median part (one on each side) and four inconspicuous on posterior part (two on each side). Carapace, cucullus, legs, and opisthosoma covered with numerous rounded granules and translucent setae. Cucullus wider than long, covered with fine translucent setae, longer distally. Opisthosoma longer than wide, tergites XI and XII wider than long, tergite XIII longer than wide; sternites XI–XIII well visible, not fused in comparison with adults. Appendages and body brown-orange, darker on opisthosoma. Measurements: Total length 5.00. Carapace 1.45 long, 1.45 wide (widest part). Cucullus 0.61 long, 1.00 wide. Opisthosoma 3.32 long, 2.22 wide. Legs tarsal formula (legs I–IV): 1-5-4-5. Variation: ($n = 2$). One specimen orange-brown in color, the other brown. Total length 4.25, 5.00 ($\bar{x}$ = 4.62). Cucullus: width 1.00, 1.00 ($\bar{x}$ = 1.00); Carapace: width 1.45, 1.45 ($\bar{x}$ = 1.45); Opisthosoma: length 3.32, 2.97 ($\bar{x}$ = 3.14); width 2.22, 1.95 ($\bar{x}$ = 2.08).

Related species.—*Pseudocellus jarocho* resembles *Pseudocellus dorotheae* from Edinburg, Texas, USA, and *P. pelaezi* from San Luis Potosi, Mexico. The resemblance with *P. dorotheae* is in the similar overall shape and in the ventral spines of patella and tibia II, but on *P. jarocho* the patella is convex ventrally, whereas on *P. dorotheae* it has a deep medial concavity; *P. dorotheae* has patella II longer than *P. jarocho*, with larger spines, particularly distally; *P. jarocho* has the spines along the two ventral rows of the tibia II larger than on *P. dorotheae* (Fig. 12), and that species has more spines than *P. jarocho*. Tibia II of *P. jarocho* has a distal concavity deeper than *P. dorotheae* (Fig. 12). The new species is larger: the total length of holotype male of *P. jarocho* is 5.15 mm, whereas the male of *P. dorotheae* is 3.15 mm long. Metatarsus III is proportionally two times slightly longer on *P. jarocho* than on *P. dorotheae*, and the metatarsal process in that species is curved, whereas on *P. jarocho* it is sigmoidal (Fig. 13). Finally, the tarsal process on *P. dorotheae* is S-shaped whereas on *P. jarocho* it is J-shaped (Figs. 13, 14).

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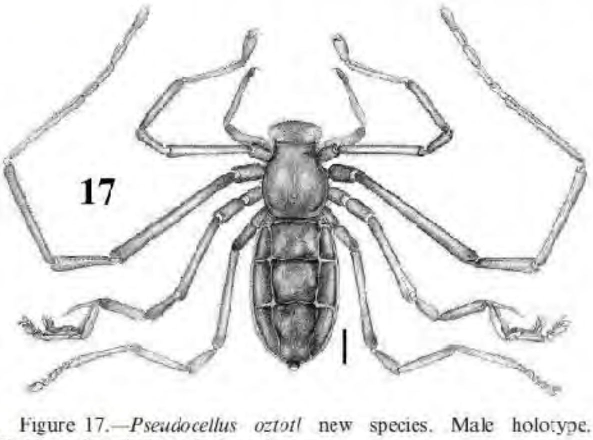


Figure 17.—*Pseudocellus oztotl* new species. Male holotype. Habitus, dorsal view. Scale = 1 mm.

The resemblance with *P. pelaezi* is in the similar shape of tibia II and in the two ventral rows of spines of tibia II, but on *P. jarocho* tibia II has a distal concavity deeper than *P. pelaezi* and the two ventral rows of spines are longer and stronger than on *P. pelaezi* (Figs. 10, 12). *Pseudocellus jarocho* is larger than *P. pelaezi*: total length of holotype male is 5.15 mm, whereas the male of *P. pelaezi* has a total length of 3.90 mm. *Pseudocellus jarocho* has femur and patellae II stronger than *P. pelaezi* (Fig. 10), although the patellae II of *P. pelaezi* has more granules ventrally than *P. jarocho*. *Pseudocellus jarocho* has two dorsal rows of strong spines on metatarsus II (Fig. 10), while *P. pelaezi* has only numerous dorsal granules, not distinctly aligned. *Pseudocellus jarocho* has small spines dorsally on tarsomeres I–III of tarsus II (Fig. 10), while *P. pelaezi* has small dorsal granules on these tarsomeres. Finally, *Pseudocellus jarocho* has metatarsus III of male longer than on *P. pelaezi*, and also *P. jarocho* has the metatarsal process thinner than on *P. pelaezi* (Fig. 13).

Distribution.—This species is known only from the type locality (Fig. 31).

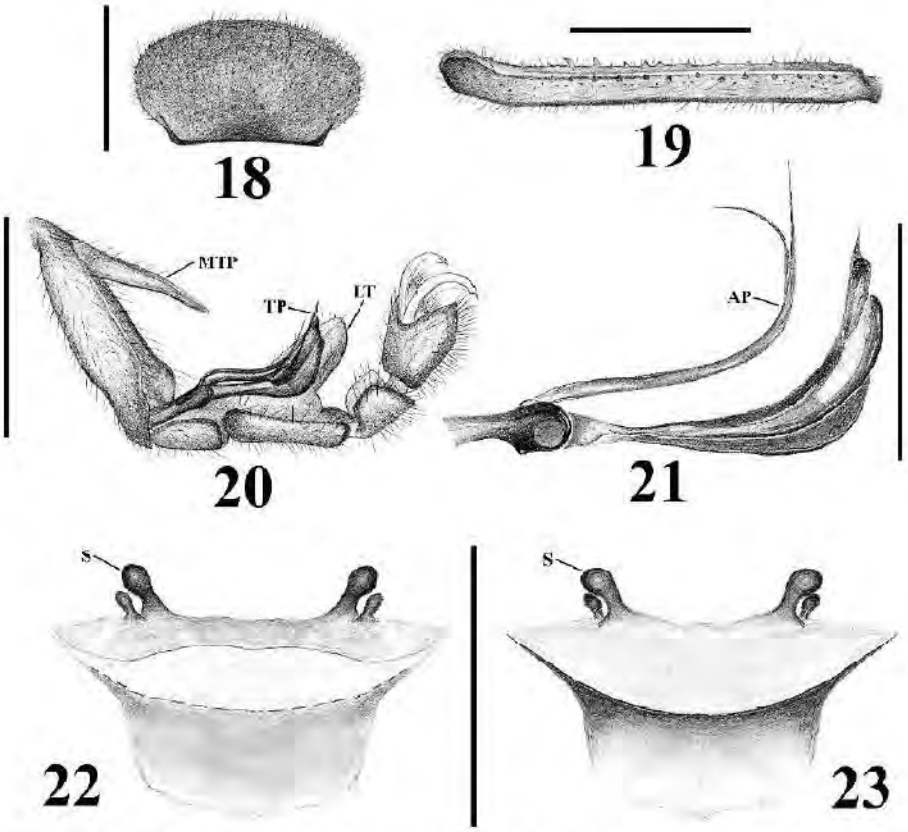
Natural history. All specimens of *P. jarocho* were collected under the same boulder, around 80 cm in diameter. The type locality is in pine-oak forest, located in an extensive karstic zone with many rocks and boulders, 2,169 m elev.

Pseudocellus oztotl new species
Figs. 17–23

Type material.—MEXICO: *Puebla*: holotype male, from "Cueva de Las Tres Quimeras" (18.31168°N, 96.84589°W), Tlacotepec de Díaz, Municipio de San Sebastián Tlacotepec, 1 April 2009, B. Shade (CNAN-T0680). Paratypes: 1 female (CNAN-T0681), 1 male (CNAN-T0682), same data as holotype.

Etymology.—The specific name is a noun in apposition, and refers to their cave habitat, '*oztotl*' means '*cave*' in the Nahuatl language, an ancient language currently spoken by some native people from Central Mexico, including the State of Puebla and the mountainous region around the type locality.

Diagnosis. Troglomorphic, pale and elongated: femur II 11 times longer than wide on males (Fig. 17), 12.5 times on female. Males can be distinguished by the two ventral rows of



Figures 18–23.—*Pseudocellus oztotl* new species. Male holotype. 18. Cucullus, dorsal view; 19. Left tibia II, dorsal view; 20. Left leg III, metatarsus and tarsal process, prolateral view; 21. Tarsal process (displaced position), prolateral view. Female paratype. Spermathecae: 22. Anterior view; 23. Posterior view. Scales = 1 mm (Figs. 18–20), 0.5 mm (Figs. 21–23).

short spines on the thin tibiae II (Fig. 19); the tarsal process wider distally and evenly curved (Fig. 21); by the distally bifurcated accessory piece of the tarsal process (displaced position) and by the shape of cucullus (Fig. 18). Females can be distinguished by the small and double rounded spermathecae (Figs. 22, 23).

Description.—*Male (holotype)*: Carapace: Longer than wide, noticeably wider posteriorly, near coxae IV; covered with numerous, long, translucent setae (Fig. 17). Median longitudinal groove distinct; dorsal concavity point-shaped, located in posterior part of longitudinal groove (Fig. 17). With four inconspicuous marginal depressions.

Cucullus: Wider than long, with numerous rounded granules, larger than those on carapace. Long translucent setae, increasing in size distally (Fig. 18).

Chelicerae: Fixed finger shorter than movable; fixed finger with six teeth, distal tooth longer than others; movable finger with seven teeth, basal tooth longer than others.

Sternal region: Coxae I meet the tritosternum distally; coxae II meet it along anterior fourth; coxae II considerably longer and wider than others.

Pedipalps: Trochanter 1 with numerous rounded granules, trochanter 2 with rounded granules ventrodistally. Femur curved distally, without rounded granules. Tibia with few, rounded granules ventrodistally. Femur and tibia with numerous translucent setae; on femur longer ventrally, on tibia longer distally.

Legs: Femora I–IV with few ventral spines. Femur II wider than others (Fig. 17). Tibia I and II with few ventral spines, longer in tibia II (Fig. 19). Tibia III and IV without spines. Metatarsus I with few dorsal spines. Metatarsus II with numerous ventral spines. Metatarsus III without granules, metatarsus IV with few dorsal spines distally.

Copulatory apparatus: Metatarsus with metatarsal process long (Fig. 20). Tarsal process wide and curved (Figs. 20, 21). Lamina cyathiformis of tarsomere 2 with slight notch basally (Fig. 20).

Opisthosoma: Longer than wide (Fig. 17). Covered uniformly with numerous, small translucent setae dorsal and ventrally. Tergites XI and XII wider than long, tergite XIII longer than wide (Fig. 17). Lateral tergites longer than wide (Fig. 17). All tergites with numerous small, rounded granules. Tergites XI–XIII with paired shallow concavities.

Coloration: Cucullus, carapace, and opisthosoma brownish, opisthosoma darker. Pedipalps and legs light brown, legs II darker. Tarsomeres on all legs pale brown.

Measurements: Total length (carapace + opisthosoma + pygidium) 6.70. Carapace 2.00 long, 1.90 wide (widest part). Cucullus 1.00 long, 1.63 wide. Opisthosoma 4.70 long, 2.66 wide (widest part). Femur II l/d: 10.25. Legs tarsal formula (legs I–IV): 1-5-4-5. Leg lengths, I: coxa 0.98/ trochanter 1 0.65/ trochanter 2 -/ femur 2.50/ patella 1.05/ tibia 1.75/ metatarsus 2.00/ tarsus 0.82/ total 9.75; II: 1.05/ 1.00 / -/ 4.10/ 1.95/ 3.00/ 3.05/ 3.25/ 17.40; III: 0.90/ 0.80/ 0.95/ 2.55/ 1.10 / 1.50/ 1.27/ 1.65/ 10.72; IV: 0.80/ 0.83/ 0.86/ 2.85/ 1.16/ 1.95/ 1.70/ 1.55/ 11.70; Pedipalp: 0.83/ 0.50/ 0.45/ 1.28/ -/ 1.88/ -/ 0.23/ 5.17. Leg formula: 2431.

Variation: (n = 2). Holotype male darker than paratype. Paired concavities on tergites XI-XIII less inconspicuous on paratype than on holotype. Total length: 6.40, 6.70 ($\bar{x}$ = 6.55), Cucullus: width 1.55, 1.63 ($\bar{x}$ = 1.59). Carapace: width 1.85, 1.90 ($\bar{x}$ = 1.87), Opisthosoma: length 4.70, 4.71 ($\bar{x}$ = 4.705), width 2.57, 2.66 ($\bar{x}$ = 2.61). Femur II l/d: 10.25, 10.75 ($\bar{x}$ = 10.50).

Female (paratype): Differs from male as follows: Femora I–IV with fewer and smaller ventral spines. Tibiae I, III–IV without ventral spines. Tibiae II with fewer and smaller ventral spines. Sternites XI, XII and XIII with paired dark, thin depressions.

Measurements: Total length 6.50. Carapace 1.90 long, 1.85 wide (widest part). Cucullus 0.96 long, 1.53 wide. Opisthosoma 4.80 long, 2.87 wide (widest part). Femur II l/d: 11.42. Legs tarsal formula (legs I–IV): 1-5-4-5. Leg lengths, I: coxa 0.95/ trochanter 1 0.63/ trochanter 2 -/ femur 2.45/ patella 0.97/ tibia 1.80/ metatarsus 1.92/ tarsus 0.76/ total 9.48; II: 1.08/ 0.95/ -/ 3.97/ 1.77/ 2.90/ 3.03/ 2.95/ 16.65; III: 0.90/ 0.75/ 0.86/ 2.73/ 1.10 / 1.82/ 1.60/ 1.26/ 11.02; IV: 0.83/ 0.85/ 0.85/ 2.86/ 1.11/ 1.92/ 1.78/ 1.38/ 11.58; Pedipalp: 0.83/0.47/ 0.43/ 1.33/ -/ 1.91/ -/ 0.26/ 5.23. Leg formula: 2431.

Related species.—*Pseudocellus oztotl* resembles *P. osorioi* from Cueva de Los Sabinos, San Luis Potosí, México, and the other new troglomorphic species described below (see discussion in the descriptions of those species below). *Pseudocellus oztotl* is longer than *P. osorioi*: the total length (carapace + opisthosoma + pygidium) of *P. oztotl* is 6.55, whereas *P. osorioi* is 5.50 mm long. It is similar to *P. osorioi* in the shape of the spines of tibia II on the male, but on *P. oztotl* the spiniform granules are bigger than on *P. osorioi* (Fig. 19). The cucullus is more rounded on *P. oztotl* than on *P. osorioi* (Fig. 18). The ocular areas are visible in *P. osorioi*, but in *P. oztotl* are not present (Fig. 17). The metatarsal process on *P. oztotl* is straight distally, whereas on *P. osorioi* it is hooked and shorter (Fig. 20). Metatarsus on leg III of male *P. oztotl* is rectangular, whereas on *P. osorioi* it is triangular. Tarsomere 1 of leg III on male *P. oztotl* is proportionately longer than on *P. osorioi* (Fig. 20). The basal part of tarsal process is longer on *P. oztotl* than on *P. osorioi* (Fig. 21). Finally, the tarsal process on *P. oztotl* is wider than on *P. osorioi*, and the tip is thin and straight in *P. oztotl* (Figs. 20, 21), and on *P. osorioi* it is wider and curved.

Pseudocellus oztotl is the fourth known species in which femur II is twice as long or longer than the carapace on adult males, i.e., which shows pronounced troglomorphism. In decreasing order of relative elongation (Femur II L/ Carapace L), first comes *Pseudocellus krejcae* Cokendolpher & Enriquez 2004, from Cebada Cave in Belize, with a ratio of 3.5, followed by *P. sbordoni* from Cueva de Las Canicas, Chiapas, with a ratio of 2.44, then *P. oztotl* with a ratio of 2.1, and finally *P. reddelli* from Cueva de Los Riscos, Durango, with a ratio of 2.0. Compared with *P. oztotl*, in *P. osorioi* the ratio is only 1.84; and in other cavernicolous, but slightly less troglomorphic species, the ratio is even lower, as follows: in *P. bolivari* from Grutas de Zapaluta, Chiapas 1.8; in *P. silvai* Armas 1977, from Cueva del Pirata, Cuba, it is 1.7; in *P. boneti* from Grutas de Cacahuamilpa, Guerrero, it is 1.5, as it is in *P. pearsei* from the Yucatan Peninsula.

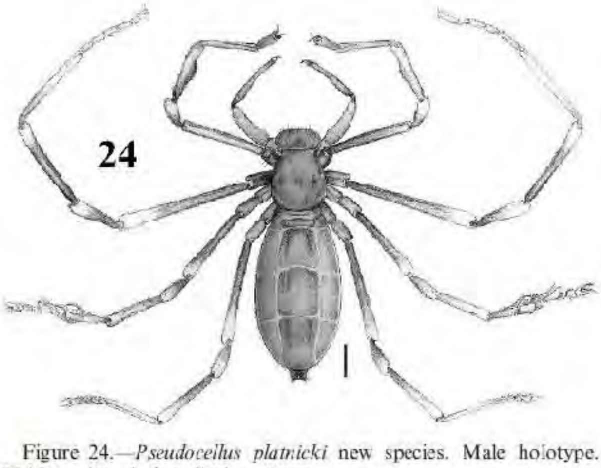


Figure 24.—*Pseudocellus platnicki* new species. Male holotype. Habitus, dorsal view. Scale = 1 mm.

Distribution.—This species is known only from the type locality (Fig. 31).

Natural history.—Cueva Las Tres Quimeras was explored by the Société Québécoise de Spéléologie in four separate expeditions from 2005 to 2009. The entrance is at 1,440 m elev.; it is 5,212 m long and drops to a depth of 815 m below entrance level. The ricinuleids were most abundant closer to the surface, where there were still big pieces of surface debris and insects floating in the water. They were found on gravel piles close to the water level (Beverly Shade, collector of the types, pers. comm., January 2011).

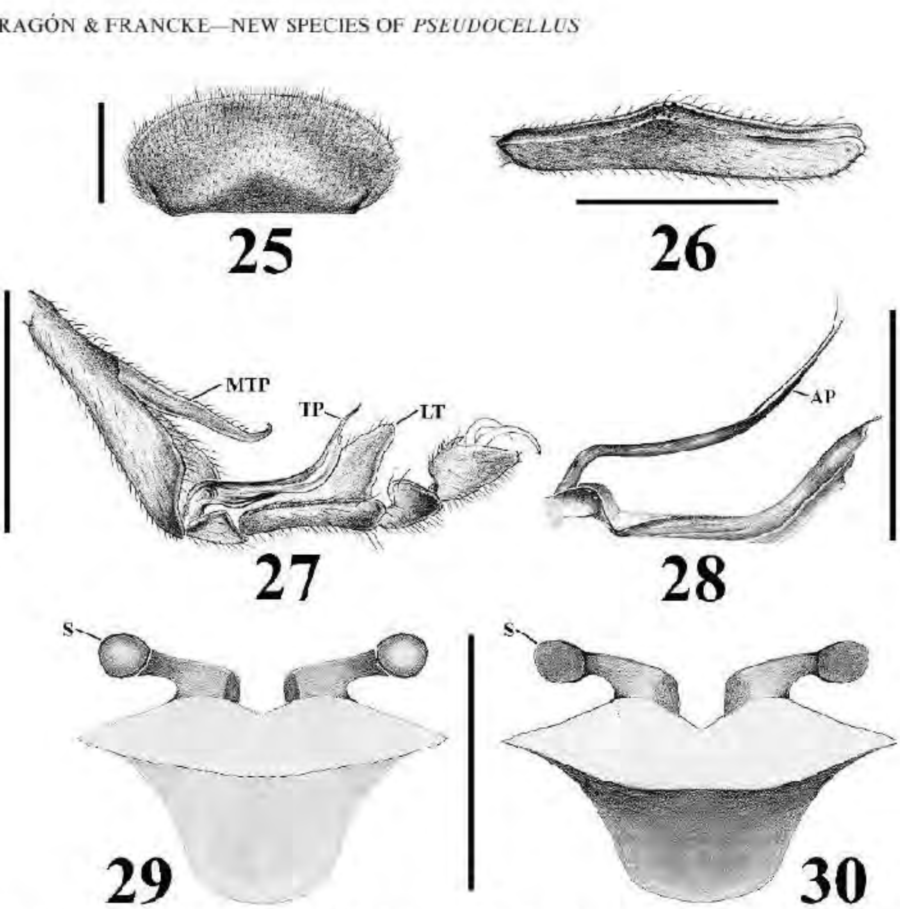
Pseudocellus platnicki new species
Figs. 24–30

Pseudocellus sp. nov. 1: Cokendolpher & Enriquez 2004:99.

Type material.—MEXICO: *Coahuila*: holotype male, Cueva Sasaparilla, Rancho Las Pilas, 130 km WSW de Ciudad Acuña (28.816667°N, 102.0000°W), 23 August 1997, D. A. Hendrickson, J. Krejca, J. C. Brown (CNAN-T0687). Paratype: 1 female (CNAN-T0688), same data as holotype.

Etymology.—This species dedicated to Dr. Norman I. Platnick (American Museum of Natural History), for his contribution to the knowledge of ricinuleids in the New World.

Diagnosis. Males can be distinguished by a granulose prolateral hump on tibia I (Figs. 24, 26); by the long femur II (Fig. 24), 10.5 times longer than wide; by having metatarsal process long, slender and curved distally (Fig. 27); and by having the tarsal process with a sharp basal bend (Fig. 28). Females can be distinguished by the long and distally rounded spermathecae (Figs. 29, 30).



Figures 25–30.—*Pseudocellus platnicki* new species. Male holotype. 25. Cucullus, dorsal view; 26. Left tibia I, ventral view; 27. Left leg III, metatarsus and tarsal process, prolateral view; 28. Tarsal process (displaced position), prolateral view. Female paratype. Spermathecae. 29. Anterior view; 30. Posterior view. Scales = 1 mm (Figs. 26–28), 0.5 mm (Figs. 25, 29, 30).

Description.—*Male (holotype):* Carapace: Longer than wide, wider posteriorly near coxae III. Evenly pitted, with few rounded granules present along inconspicuous dorsal depression: one central, two on median part (one on each side of midline) and two on posterior part (one on each side of midline). Covered with numerous small, translucent setae (Fig. 24). Ocular areas located along coxae II and III.

Cucullus: Wider than long. Evenly pitted; with few, scattered small round granules basally (Fig. 25); covered with small translucent setae, some longer than others (Fig. 25).

Chelicerae: Fixed finger shorter than movable. Left fixed finger with six teeth, right finger with five teeth, the last two teeth longer than the others on both fingers. Left movable finger with five teeth of different sizes; right finger with five teeth, basal tooth distinctly longest.

Sternal region: Coxae I meet tritosternum in a single point; coxae II meet it along anterior third, coxae II longer than the others. All coxae evenly pitted, without granules.

Pedipalps: Coxa evenly pitted. Trochanter 1 pitted, with 1–5 granules distally. Trochanter 2, femur and tibia evenly pitted, without granules. All segments covered with translucent setae, shorter on tibia; tibia distally with a few setae longer than on other segments.

Legs: Covered with small translucent setae. All segments elongated and thin, evenly pitted, without spines and granules (Fig. 24), except granules on retrolateral part of coxa I and tibia I with a granulose prolateral hump (Figs. 24, 26). Tarsus III covered ventrally with numerous, long setae. Tarsal claws long. Tarsi I and II with a distal projection between the tarsal claws.

Copulatory apparatus: Metatarsus elongate, conical; metatarsal process elongate, curved distally (Fig. 27). Tarsomere 2 elongate, square (Fig. 27). Lamina cyathiformis of tarsomere 2 triangular (Fig. 27). Tarsal process ending in thin tip (Fig. 27).

Opisthosoma: Longer than wide, widest at midpoint along tergite XII (Fig. 24). Pitted, with few small granules anteriorly on tergites X–XII and first two marginal tergites (Fig. 24). Tergite XI wider than long, tergites XII and XIII longer than wide. Sternites evenly pitted, on sternites XI and XII quite conspicuously. Pygidium basal segment distally with small dorsal notch.

Coloration: Cucullus, carapace, pedipalps, and coxae of legs pale orange. Trochanters I and II orange, trochanters III and IV pale orange. Femorae, patellae, tibiae and metatarsi brownish, on each segment paler distally. Tarsi pale orange. Opisthosoma yellowish, sternites XI and XII dark orange. Pygidium brownish.

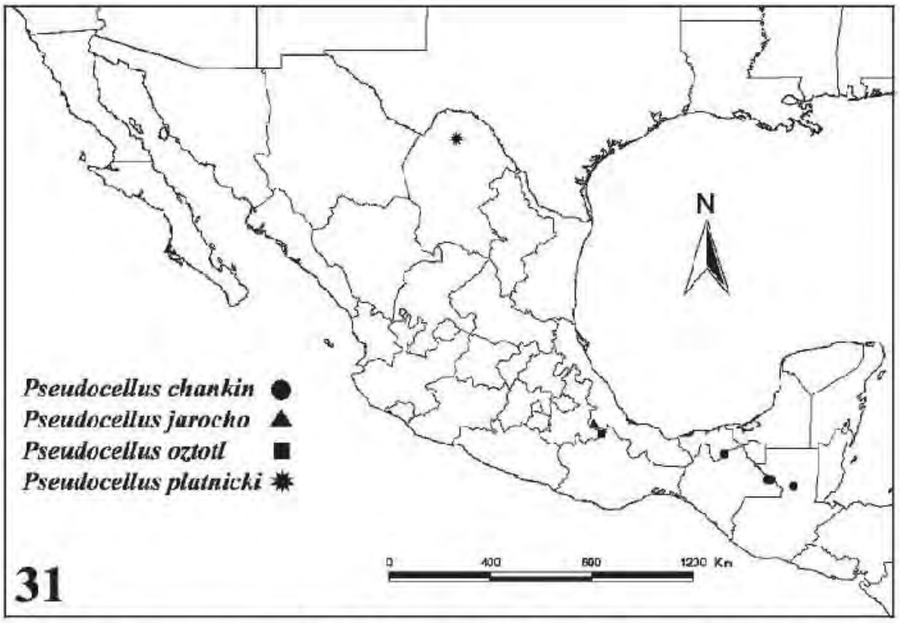


Figure 31.—Distribution records of *Pseudocellus chankin*, *P. jarocho*, *P. oztotl* and *P. platnicki*.

Measurements: Total length (carapace + opisthosoma + pygidium) 6.20. Carapace 1.70 long, 1.55 wide (widest part). Cucullus 0.87 long, 1.42 wide. Opisthosoma 4.30 long, 2.35 wide (widest part). Femur II l/d: 10.57. Legs tarsal formula (legs I–IV): 1-5-4-5. Leg lengths, I: coxa 0.80/ trochanter 1 0.61/ trochanter 2 -/ femur 2.30/ patella 0.82/ tibia 1.65/ metatarsus 1.77/ tarsus 0.73/ total 8.68; II: 0.90/ 0.80/ -/ 3.67/ 1.45/ 2.65/ 2.52/ 2.37/ 14.36; III: 0.81/ 0.70/ 0.81/ 2.45/ 1.07/ 1.62/ 1.25/ 1.45/ 10.16; IV: 0.73/ 0.78/ 0.76/ 2.85/ 1.05/ 1.90/ 1.75/ 1.27/ 11.09; Pedipalp: 0.7/ 0.47/ 0.32/ 1.32/ -/ 1.80/ -/ 0.30/ 4.91. Leg formula: 2431.

Female (paratype): Differs from male as follows: Tibia I without granulose prolateral hump. Cheliceral fixed finger with five teeth, distal tooth longer than the others. Both movable fingers of chelicerae with five teeth, decreasing in size distally. Cucullus, carapace and legs brown. Opisthosoma, tergites and sternites orange; sternite XI paler than the others.

Measurements: Total length 6.40. Carapace length 1.82, width 1.67 (widest part). Cucullus length 0.85, width 1.40. Opisthosoma length 4.55, width 2.50 (widest part). Femur II l/d: 10.71. Legs tarsal formula (legs I–IV): 1-5-4-5. Leg lengths, I: coxae 0.76/ trochanter 1 0.56/ trochanter 2 -/ femur 2.37/ patella 0.90/ tibia 1.75/ metatarsus 1.85/ tarsus 0.70/ total 8.89; II: 0.95/ 0.80/ -/ 3.75/ 1.50/ 2.65/ 2.55/ 2.40/ 14.60; III: 0.86/ 0.63/ 0.73/ 2.65/ 1.06/ 1.77/ 1.70/ 1.18/ 10.58; IV: 0.80/ 0.78/ 0.80/ 2.90/ 1.06/ 1.96/ 1.80/ 1.27/ 11.37; Pedipalp: 0.75/ 0.47/ 0.43/ 1.46/ -/ 1.92/ -/ 0.35/ 5.38. Leg formula: 2431.

Related species.—*P. platnicki* resembles *P. osorioi* from Cueva de Los Sabinos, San Luis Potosí, México, and *P. oztotl* from Cueva Las Tres Quimeras, Puebla, México. The resemblance with *P. osorioi* lies in the overall shape, both are large species of similar size, elongated appendages: *P. platnicki* has a total length of 6.20 mm whereas *P. osorioi* is 6.30 mm long; however, *P. platnicki* has the body and appendages evenly pitted and with very few granules, while *P. osorioi* is not pitted and has numerous granules. On *P. platnicki* the cucullus is oval (Fig. 25), whereas on *P. osorioi* it is pentagonal. Tibia I on *P. platnicki* has a granulose prolateral hump (Fig. 26), which is lacking on *P. osorioi*; tibia II on *P. osorioi* has ventral spines, whereas on *P. platnicki* it lacks spines and granules (Fig. 24). Both species resemble in the shape of the copulatory apparatus of leg III of male: *P. platnicki* has the metatarsal process thinner than *P. osorioi*; finally, *P. platnicki* has the tarsal process wider on the distal half, whereas on *P. osorioi* the tarsal process is slender and conical distally.

Pseudocellus platnicki is similar to *P. oztotl* in overall shape; also, both species have elongated appendages and similar size, *P. platnicki* is 6.20 mm long, whereas *P. oztotl* is 6.70 mm (Figs. 17, 24). Tibia I on *P. platnicki* has a granulose prolateral hump (Figs. 24, 26), while *P. oztotl* has tibia I with spines ventrally and without a granulose prolateral hump (Fig. 17); tibia II on *P. oztotl* has spines ventrally (Fig. 19), whereas on *P. platnicki* it lacks spines and granules (Fig. 24). The metatarsal process on *P. platnicki* is slender and curved distally, whereas on *P. oztotl* it is conical and straight distally (Figs. 20, 27); the tarsal process is thinner on *P. platnicki* than on *P. oztotl* (Figs. 20, 28). Finally, on females the shape of the spermathecae is very different between *P. platnicki* and *P. oztotl* (Figs. 22, 23, 29, 30).

Distribution. This species is known only from the type locality (Fig. 31).

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Appendix 1.—Material examined to make the key for identification of Mexican *Pseudocellus*:

Pseudocellus boneti: México: Guerrero: 1 ♂ (CNAN-Ri0009) from Gruta de Acuitlapan (cave); 1 ♀ (CNAN-Ri0010), same location; 1 ♂ (CNAN-Ri0011) from Gruta de la Mariposa, Tetipac (cave); 1 ♀ (CNAN-Ri0012), same location.

Pseudocellus gertschi: México: Veracruz: 3♀, 3 nymphs (CNAN-Ri0002) from Estación Biológica de la UNAM "Los Tuxtlas" (litter).

Pseudocellus osorioi: México: San Luis Potosí: 3 ♀, 1 nymph (CNAN-Ri0004) from Sótano del Tigre, Sierra del Abra (cave); Tamaulipas: 1 ♀ (CNAN-Ri0008) from Cueva de Quintero (cave).

Pseudocellus pearsei: México: Quintana Roo: 1 ♂ (CNAN-Ri0013) from Caverna "Aktum Chen" (cave); Yucatán: 2 ♂, 4 ♀, 12 nymphs (CNAN-Ri0007) from Cenote Mayapan (cave); 3 ♂, 2 ♀, 2 nymphs (CNAN-Ri0014) from Actun Isban, 1.3 km SE of San Francisco Grande (litter); 1 ♂, 2 ♀, 1 nymph (CNAN-Ri0015), same location; 4 ♀ (CNAN-Ri0016) from Cenote Xcoptiel, Xcoptiel, 4.5 km SSW Dzeal. (cave); 6 ♂, 3 ♀, 3 nymphs (CNAN-Ri0017) from Actun Olem, 1.4 km N Xbohom (litter); 2 ♂, 3 ♀, 1 nymph (CNAN-Ri0018) from Actun Yax, 5.2 km SSW Kaua (cave); 4 ♀, 2 nymphs (CNAN-Ri0019) from Grutas de San Daniel, 1.6 km N of Quintana Roo Plaza (cave).

Pseudocellus pelaezi: México: Tamaulipas: 2 ♂, 2 ♀, 4 nymphs (CNAN-Ri0005) from Cueva de la Florida, Sierra del Abra (cave).

Pseudocellus spinotibialis: México: Chiapas: 1 ♂ (ECOTAAR-Ri00001), 1 ♂ (ECOTAAR-Ri00002), 1 ♀ (ECOTAAR-Ri00003), 1 ♀ (ECOTAAR-Ri00007), 1 ♀ (ECOTAAR-Ri00009) from Unión Juárez, Talquian C. (cave).

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A new species of the spider genus *Pomboa* Huber (Araneae: Pholcidae) from Colombia

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The spider genus *Pomboa* Huber, 2000 (Pholcidae: Modisiminae), includes three species, all from Colombia: *P. cali* Huber; *P. pallida* Huber; and *P. quindio* Huber (Platnick, 2012). The spiders are medium-size (1.7-3.3 mm), and show only slight sexual dimorphism (Huber, 2000). The monophyly of the genus is supported by the widely curved procursus. In *P. pallida* and *P. quindio*, the procursus bears a dorsoproximal spine that is accompanied by membranous fringes (Huber, 2000). The relationships of the genus are not yet clear (Huber, 2011). In this paper a fourth species of *Pomboa* is described.

The specimens were examined, measured and photographed with a Nikon SMZ645 stereoscope. All measurements are in mm. Methods of dissection and photography follow Valdez-Mondragón (2010). The specimens are deposited in ethanol (80%) in the Colección Nacional de Arácnidos (CNAN) of the Instituto de Biología, UNAM. Abbreviations: ALE, anterior lateral eyes, AME, anterior median eyes. M, membrane of the spine. PA, proximal apophysis of chelicerae. PME, posterior median eyes. PP, pore plates.

Pomboa quimbaya new species
Figures 1-14

Type material. *COLOMBIA: Quindío:* 1 male holotype (CNAN T0083), [4 December 2011; A. Valdez] from Universidad del Quindío, Ciudad de Armenia (lat 4.554488°, lon -75.661957; 1520 m), collected in tropical forest inside the university campus. Paratypes: 1 female (CNAN T0084); 5 males, 1 female (CNAN T0085), same data as holotype.

Etymology. The specific name is a noun in apposition and refers to the ethnic group and cultural region named *Quimbaya*, from Colombia.

Diagnosis. Distinguished from *P. cali* by the proximal apophyses on chelicerae (PA) which are larger and rounded with numerous setae (left arrow Fig. 4). From *P. quindio* by the presence of small and conical apophyses in distal part of the chelicerae, away from the fangs (right arrow Fig. 4). From *P. pallida* by its thinner, longer and curved procursus, with a dorsal large spine in proximal part (arrow, Fig. 8); this spine bears a longer membrane (M) (Figs 8, 9). From other known congeners by the presence of two sclerotized and curved projections distally to the embolus, the ventral one longer than the dorsal (Figs 7, 9); by the epigynum with a wide and curved apophysis in ventral view (arrow, Fig. 11); and by the epigynum with a median heart-shaped plate and two lateral oval plates (Figs 12, 13).

Description. Male (Holotype). *Prosoma:* Pale beige, carapace marginally with a wide dark, gray, arc-shaped pattern on each side (Fig. 2). Ocular region gray, slightly elevated (Figs 1, 3). Fovea surrounded by wide gray region, joining posteriorly with the marginal gray pattern of the carapace (Fig. 2). Clypeus pale orange, with a wide gray longitudinal pattern (Fig. 3). Chelicerae brown in retrolateral part (Fig. 5), orange prolaterally, and brownish distally (Figs 4, 5). Sternum dark orange, with a gray central pattern (Fig. 6). Labium gray; endites pale gray basally and dark gray distally; labium and endites white apically (Fig. 6). Endites with retrolateral apophysis (arrow, Fig. 6). *Legs:* Coxae pale gray. Trochanters brown. Femora dark gray. Patellae, tibiae and metatarsi dark brown. Legs with high density of small vertical setae. Tibiae and metatarsi with curved setae. Tarsi pale brown. Femur I wider than the others. *Opisthosoma:* Blue, semi globular, longer than high (Fig. 1). Plate of genital gonopore olive, small, wider than long, located ventrally on median part of opisthosoma. Ventrally, two blue thin lines in front of the plate of genital gonopore, and one wide and short line behind it. *Palp:* Femur orange, conical, curved ventrally; basally with oval retrolateral apophysis; ventrally with sub-distal small rounded apophysis (Fig. 8). Patella dark orange and tibia brown. Procursus

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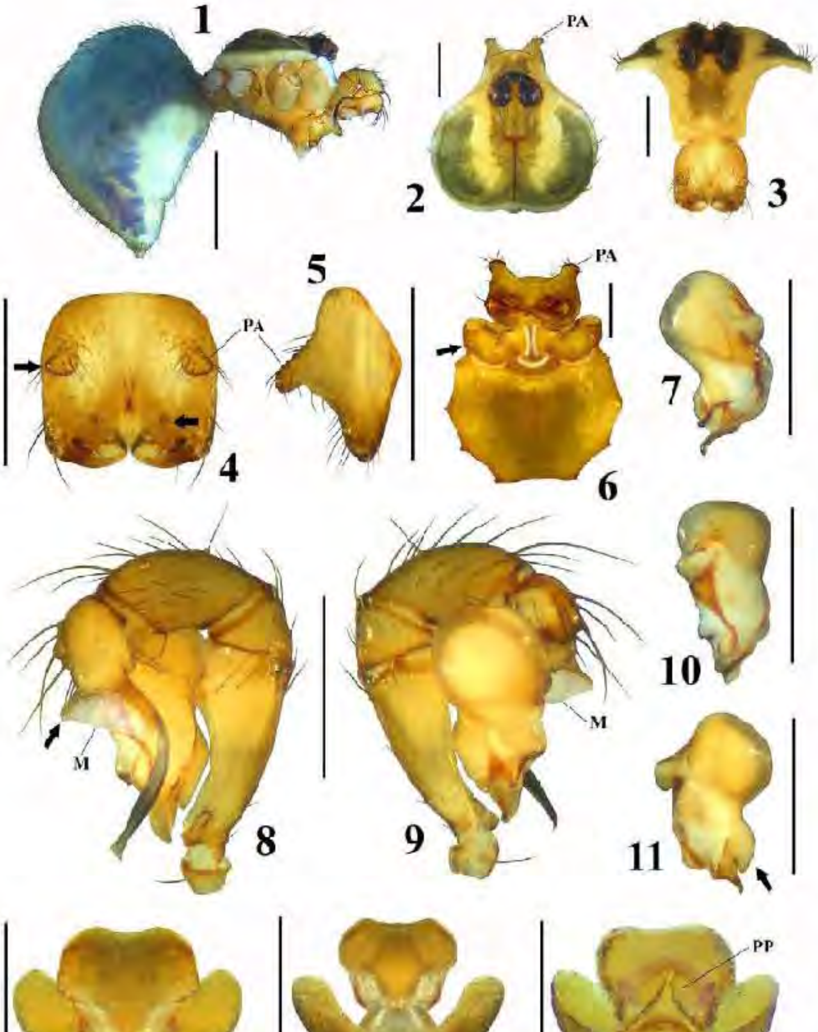
orange and wide basally, black in the distal half of the curved part (Figs 8, 9). Embolus short, retrolaterally part with a sclerotized reddish line (Fig. 10), ending near the spermatic aperture; distally with two curved sclerotized projections (Fig. 7). *Measurements:* Total length 3.30. Carapace 1.47 long, 1.50 wide. Clypeus 0.58 long. Distance ALE-PME 0.12. PME-PME 0.15. Diameter AME 0.08. PME 0.13. Leg I: 31.32 (femur 7.60 + patella 0.60 + tibia 8.15 + metatarsus 12.60 + tarsus 2.37), tibia II: 5.15, tibia III: 3.90, tibia IV: 4.95; tibia I l/d 51.25.



FIGURES 1—14. *Pomboa quimbaya* **new species**. Male (Holotype). 1, Habitus, lateral view. 2-3, Carapace, dorsal and frontal views respectively. 4-5, Chelicerae, frontal and lateral views respectively (left and right arrows indicate the proximal rounded apophyses and the distal conical apophyses on chelicerae respectively). 6, Prosoma, ventral view (arrow indicates the retrolateral apophysis of the endites). 8-9 Left palp, retrolateral and prolateral views respectively (arrow indicates dorsal spine of procursus). 7, 10, 11: Left bulb, dorsal, retrolateral and ventral views respectively (arrow indicates the wide and curved ventral apophysis). Females (Paratypes): 12-13, Epigynum variation, ventral view. 14, Epigynum, dorsal view. Scales: 1 mm (Fig. 1), 0.5 mm (Figs 2-11), 0.4 mm (Figs 12-14).

Female (Paratype). (CNAN T0084). Similar to the male, differences: *Prosoma:* Clypeus with a gray longitudinal line wider than on males. Chelicerae brown. Sternum with a gray pattern lighter and wider than on males. Labium and endites brown. *Legs:* Femora, patellae, tibiae, metatarsi and tarsi brown, with less density of small vertical hair than the male. Leg I with the same width as the others legs. *Opisthosoma:* Blue, paler than on male, ventrally without lines or pattern. *Epigynum:* Wider than long (Figs 12, 13), located in posterior part of the opisthosoma, near the spinnerets. PP oval, near to each other in diagonal position (Fig. 14). *Measurements.* Total length 2.80. Carapace 1.20 long, 1.32 wide.

Clypeus 0.40 long. Distance ALE-PME 0.12. PME-PME 0.11. Diameter AME 0.06. PME 0.12. Leg I: 22.00 (5.40+0.50+6.00+9.10+1.00), tibia II: 3.70, tibia III: 2.80, tibia IV: 3.60; tibia I l/d 40.00.

Variation: (males N = 6, females N = 2). There is variation in the size and shape of the epigynum. In the female paratype (CNAN T0084; Fig. 12) the median heart-shaped plate is larger than in the female paratype (CNAN T0085; Fig. 13); moreover, in the paratype the median plate is next to the two lateral oval plates (Fig. 12), whereas in the other female the median plate is separated from the lateral plates (Fig. 13). *Males:* Carapace: width 1.20-1.60 (x= 1.39); tibia I: 8.10-9.90 (x= 8.60); distance between apophyses on chelicerae: 0.35-0.45 (x= 0.41); *Females:* Carapace: width 1.25, 1.32; tibia I: 5.70, 6.00; epigynum: length 0.40, 0.45; width 0.65, 0.70.

Life history and habitat preferences. The specimens were collected from their irregular sheet webs. The webs were made in crevices in road-cuts, about 40 cm from the ground.

Distribution. Known only from the type locality.

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Two new species of ricinuleids of the genus *Pseudocellus* (Arachnida: Ricinulei: Ricinoididae) from southern Mexico

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Abstract

Two new species of ricinuleids of the genus *Pseudocellus* are described from Mexico: *Pseudocellus cruzlopezi* **sp. nov.** from Oaxaca, and *Pseudocellus monjarazi* **sp. nov.** from Chiapas. Both species are described from adult males and females. The first species is epigean and edaphomorphic, whereas the second is cavernicolous and troglomorphic. The number of known species of the genus *Pseudocellus* increases to 25, and Mexican species to 16, indicating that Mexico has the highest diversity of ricinuleids in the world. An updated identification key to adult males of the 16 described species found in Mexico and southern USA is provided.

Key words: *Pseudocellus*, taxonomy, troglomorphism, Oaxaca, Chiapas

Resumen

Dos especies nuevas de ricinúlidos del género *Pseudocellus* son descritas de México: *Pseudocellus cruzlopezi* **sp. nov.** de Oaxaca, y *Pseudocellus monjarazi* **sp. nov.** de Chiapas. Ambas especies son descritas de machos y hembras adultos. La primera especie es epigea y edafomórfica, mientras que la segunda es cavernícola y troglomórfica. El número de especies conocidas del género *Pseudocellus* incrementó a 25, y las especies mexicanas a 16, por lo que México tiene la más alta diversidad de ricinúlidos en el mundo. Una clave de identificación actualizada para machos adultos de las 16 especies descritas y registradas en México y Estados Unidos es proporcionada.

Introduction

Currently, the class Arachnida Lamarck, 1801 is composed of 11 orders, of which Ricinulei is the least diverse. Two suborders are recognized: Palaeoricinulei Selden 1992 and Neoricinulei Selden, 1992. Palaeoricinulei is composed of 16 fossil species in two families: Curculioididae Cockerell, 1916 (genera *Amarixys* Selden, 1992 and *Curculioides* Buckland, 1837) and Poliocheridae Scudder 1884 (genera *Poliochera* Scudder, 1884 and *Terpsicroton* Selden, 1992). Neoricinulei is represented by a single family, Ricinoididae Ewing, 1929, with the genera *Cryptocellus* Westwood, 1874 *Pseudocellus* Platnick, 1980 and *Ricinoides* Ewing, 1929, with a total of 73 living species (Selden 1992; Harvey 2002, 2003; Botero-Trujillo & Pérez 2008, 2009; Tourinho & Azevedo 2007; Teruel & Armas 2008, Tourinho & Saturnino 2010; Tourinho *et al.* 2010; Valdez-Mondragón & Francke 2011; Pinto-da-Rocha & Andrade 2012).

Mexico has the highest diversity of ricinuleids in the world, as well as the largest number of cavernicolous species troglomorphic modifications. Fourteen species of the genus *Pseudocellus* are known from Mexico, not including the two new species described here: *P. bolivari* (Gertsch, 1971); *P. boneti* (Bolívar y Pieltain, 1942); *P. chankin* Valdez-Mondragón & Francke, 2011; *P. gertschi* (Márquez & Conconi, 1974); *P. jarocho* Valdez-Mondragón & Francke, 2011; *P. mitchelli* (Gertsch, 1971); *P. osorioi* (Bolívar & Pieltain, 1946); *P. oztotl* Valdez-

Mondragón & Francke, 2011; *P. pearsei* (Chamberlin & Ivie, 1938); *P. pelaezi* (Coronado-Gutierrez, 1970); *P. platnicki* Valdez-Mondragón & Francke, 2011; *P. reddelli* (Gertsch, 1971); *P. sbordonii* (Brignoli, 1974) and *P. spinotibialis* (Goodnight & Goodnight, 1952). Seven of them are conspicuously troglomorphic, with elongated appendages: *P. bolivari*, *P. boneti*, *P. osoroi*, *P. oztotl*, *P. platnicki*, *P. reddelli* and *P. sbordonii*.

Ricinuleids are generally found in leaf litter and in the soil under rocks, logs, and even inside the ground (Cokendolpher & Enríquez 2004), but many species of the genus *Pseudocellus* inhabit caves, and some species, such as *P. oztotl*, have been collected at depths of up to 815 m below entrance level (Valdez-Mondragón & Francke 2011). Currently, there are 7022 registered caves in Mexico, although many of them have multiple registered entrances and are interconnected, forming long systems of caverns (P. Sprouse, *in litt*). Although there have been many works concerning the biodiversity of ricinuleids in Mexican caves (Bolívar y Pieltain 1946, Gertsch 1971, 1977, Pittard & Mitchell 1972, Brignoli 1973, Reddell 1981, Cokendolpher & Enríquez 2004, Valdez-Mondragón & Francke 2011), thousands of caves remain unexplored biologically. Therefore it is very likely that the diversity of troglobitic ricinuleids from Mexico will continue to increase as biospeleologists explore those caves.

In this work two new species of *Pseudocellus* are described from the Mexican states of Oaxaca and Chiapas. One is known only from the surface, collected in the ground under boulders in a tropical rainforest, and does not appear troglomorphic. The other is known from a karst cave surrounded by oak forest; it has elongated appendages, a typical troglomorphism among cave arthropods.

Material and methods

The specimens, preserved in 80% ethanol, were examined, measured and photographed with a Nikon SMZ645 stereoscope. The photographs were taken with a Nikon Coolpix S10 VR camera with adapter for the stereoscope. The metatarsus and tarsal process of leg III were dissected, critical-point dried, and examined at low vacuum in a HITACHI S-2460N scanning electron microscope (SEM). All measurements are given in millimeters and were made following the procedures of Cooke & Shadab (1973). We named the segments of the legs following Gertsch (1971). The names of copulatory structures follow Pittard & Mitchell (1972).

The Nikon SMZ645 stereoscope was used to make drawings of the spermathecae. All structures photographed and drawn under the stereoscope were submerged first in gel alcohol (available commercially as a hand cleaner), the consistency of the gel allowing the immobilization and positioning of the structure. The structure submerged in the gel alcohol was then covered with liquid ethanol 80% to minimize diffraction during examination and photography. The map was made with ArcView GIS Version 3.2 (Applegate 1999). Images were edited with Adobe Photoshop 7.0. All the specimens are deposited in the Colección Nacional de Arácnidos (CNAN), at the Instituto de Biología, Universidad Nacional Autónoma de México (UNAM).

Morphological abbreviations used in the descriptions are: AP, accessory piece of tarsal process; LT, lamina of tarsomere 2; MTP, metatarsal process; S, spermathecae; TP, tarsal process.

Taxonomy

Family Ricinoididae Ewing, 1929

Genus *Pseudocellus* Platnick, 1980

Type species. *Pseudocellus dorotheae* (Gertsch & Mulaik, 1939).

Key to adult males of *Pseudocellus* species from Mexico and USA

1 Troglomorphic species with all appendages elongated (Fig. 14): femur II at least 1.5× longer than carapace; tibia II longer than carapace. 2

\- Edaphomophic species with short appendages (Fig. 1): femur II less than 1.5× carapace length; tibia II shorter than carapace 9

2 Femur II length/width ratio greater than 9; femur II over twice as long as carapace 3

\- Femur II length/width ratio less than 9; femur II less than twice as long as carapace 6

3 Cheliceral fingers with 5 teeth . . . . *P. reddelli* (Durango, Mexico)

\- Cheliceral fingers with more than 5 teeth 4

4\. Leg formula 2413; tibia II twice as long as patella II . . . . *P. sbordonii* (Chiapas, Mexico)

\- Leg formula 2431; tibia II less than twice as long as patella II 5

5 Tibia I with a granulose prolateral hump (Valdez-Mondragón & Francke 2011, figs. 24, 26); tibia II and tarsus II unarmed . . . . *P. platnicki* (Coahuila, Mexico)

\- Tibia I without a granulose prolateral hump (Valdez-Mondragón & Francke 2011, fig. 17); tibia II and tarsus II with two distinct rows of spines prodorsally and proventrally (Valdez-Mondragón & Francke 2011, fig. 19) . . . *P. oztotl* (Puebla, Mexico)

6 Leg formula 2341; cheliceral fixed finger with 4 teeth; tarsal claws asymmetrical, some spatulate . . . . *P. bolivari* (Chiapas, Mexico)

\- Leg formula 2431; cheliceral fixed finger with 5 or 6 teeth; tarsal claws symmetrical, none spatulate 7

7 Tibia II elongated, around 11× longer than wide, with scattered spines or scattered granules prolaterally 8

\- Tibia II shorter, around 6× longer than wide, with two distinct rows of spines prolaterally . . . . . . *P. boneti* (Guerrero, Mexico)

8 Tibia II with a few scattered spines prolaterally; cheliceral movable finger with teeth uniform in size . . . . *P. osorioi* (San Luis Potosí, Mexico)

\- Tibia II without scattered spines, only with numerous granules prolaterally (Fig. 17); cheliceral movable finger with teeth longer basally than distally (Fig. 18) . . . . *P. monjarazi* new species (Chiapas, Mexico)

9 Tibia II armed with one or two distinct tubercles prolaterally (Valdez-Mondragón & Francke 2011, fig. 3) 10

\- Tibia II without distinct tubercles prolaterally (Figs 4, 5) 12

10 Femur II moderately thickened, 4× longer than wide; tibia II with a single prodorsal tubercle, lacking a distinct proventral tubercle . . . . *P. pearsei* (Yucatán, Mexico)

\- Femur strongly thickened, less than 2.5× longer than wide; tibia II with prodorsal and proventral tubercles subequal in size 11

11 Femur II shorter than carapace; tibia II with prodorsal and proventral tubercles aligned, situated medially . . . . *P. spinotibialis* (Chiapas, Mexico)

\- Femur II distinctly longer than carapace; tibia II with tubercles not aligned, proventral tubercle in basal third, and prodorsal one in distal third (Valdez-Mondragón & Francke 2011, figs. 1, 3) . . . . *P. chankin* (Chiapas, Mexico; Petén, Guatemala)

12 Leg formula 2431; carapace and opisthosoma distinctly and evenly pitted 13

\- Leg formula 2341; integument not distinctly pitted 14

13 Adult 3.2 mm in total length; tibia II slightly over 0.5× carapace length; patella II and tibia II subequal in length . . . . *P. dorotheae* (Texas, USA)

\- Adult 5.0 mm in total length; tibia II almost equal to carapace length; tibia II 1.5× longer than patella II . . . . *P. mitchelli* (Durango, Mexico)

14 Femora I and IV conspicuously enlarged, at least 1.5× thicker than preceding and following segments . . . . *P. gertschi* (Veracruz, Mexico)

\- Femora I and IV not enlarged, about same thickness as preceding and following segments (Fig. 1) 15

15 Femur II thickened (Fig. 1), around 2.5× longer than wide; tibia II at least 1.5× length of patella II 16

\- Femur II not thickened, slightly over 4× longer than wide; tibia II 1.2× longer than patella II . . . . *P. pelaezi* (San Luis Potosí, Mexico)

16 Tarsal process of leg III narrow, with two tips distally (Valdez-Mondragón & Francke 2011, figs 13–14) . . . . *P. jarocho* (Chiapas, Mexico)

\- Tarsal process of leg III wide, ending in a single, long, thin and sharp tip (Figs 10–12) . . . . *P. cruzlopezi* new species (Oaxaca, Mexico)

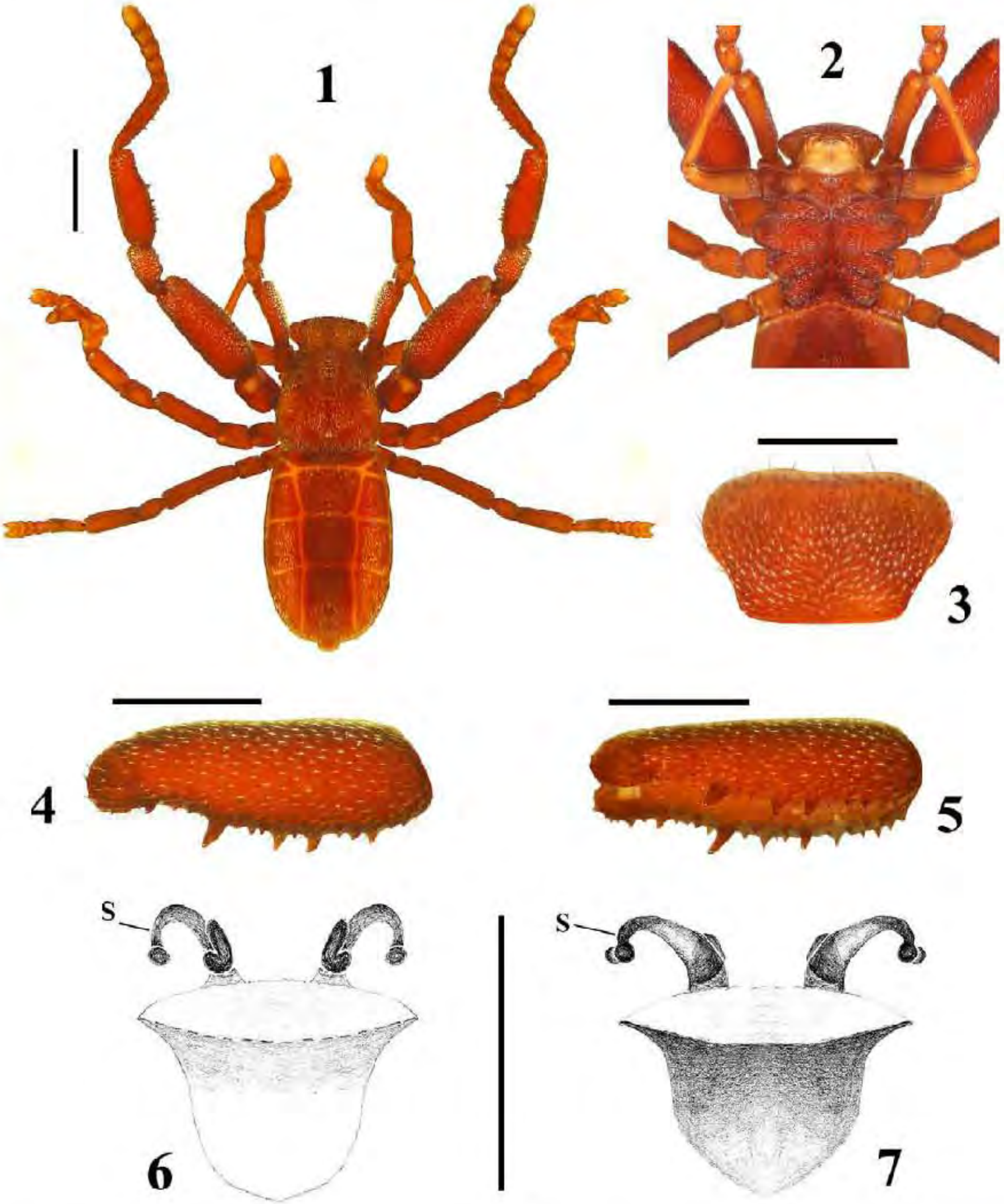
***Pseudocellus cruzlopezi* sp. nov.**
Figs. 1–13

Type material. Male holotype (CNAN-T0706), 1 female and 1 tritonymph paratypes (CNAN-T0707), from MEXICO: *Oaxaca*, Municipio San José Tenango, Cerro Caballero (lat. 18.13580°, long. -96.68970°; alt. 943 m), 30 September 2008, J. Cruz.

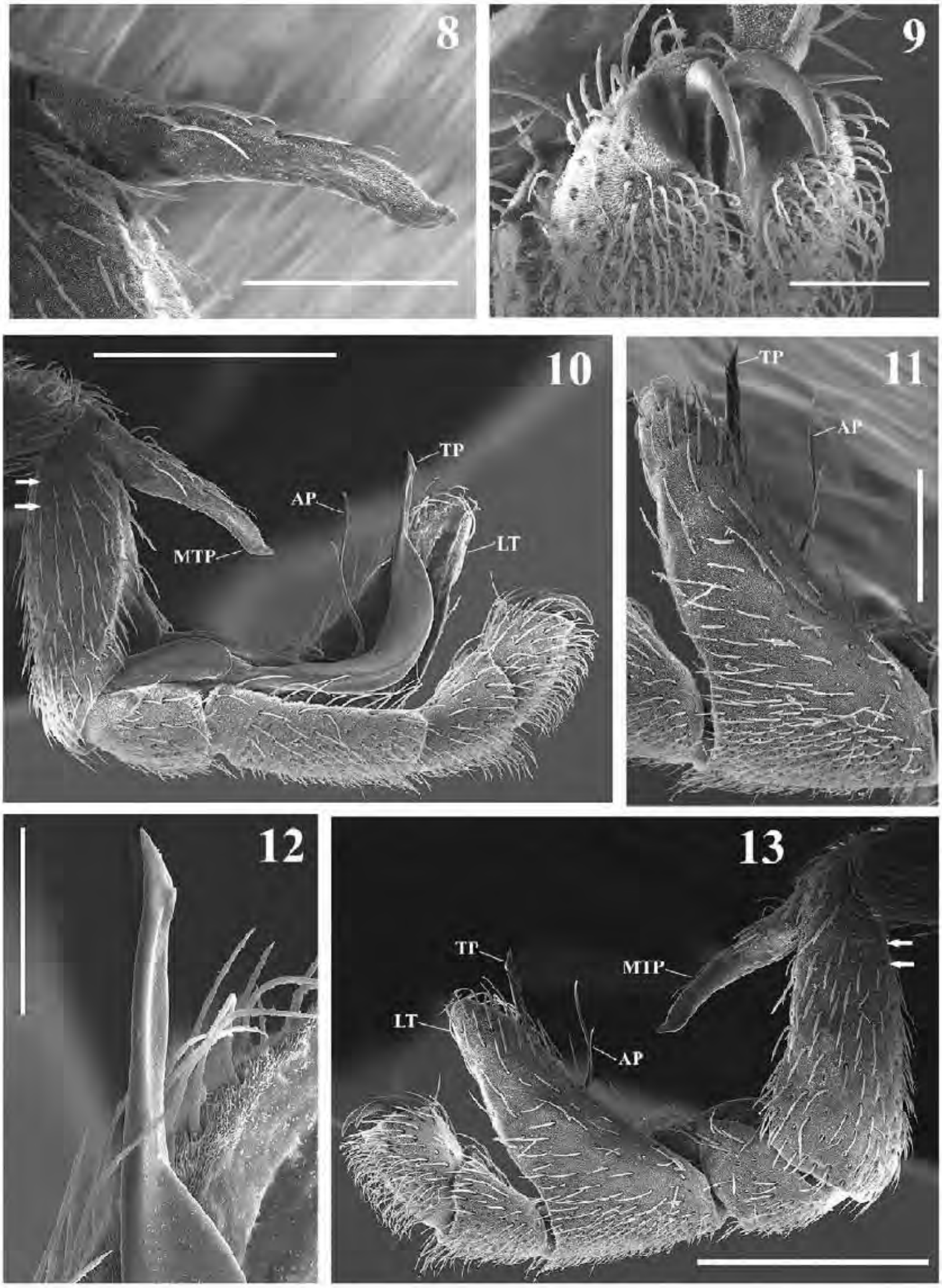
Etymology. The specific name is dedicated to the opilionologist M. Sc. Jesús Alberto Cruz-López for his contribution to the knowledge of arachnids from Mexico and who collected all the known specimens.

Diagnosis. Males can be distinguished by the following combination of characters: two ventral rows of curved spines on tibia II, which are small basally and become longer distally (the last distal spines on both rows longest (Figs 4, 5)); the very robust femur II (Fig. 1), 2.4 times longer than wide; tarsal process of leg III wide, ending in a long, thin, sharp tip (Figs 10–12); accessory piece of tarsal process bifurcate (Figs 10–11, 13); the long, conical and sigmoid metatarsal process (Figs 10, 13); and the cucullus with a trapezoidal shape, rounded laterally (Fig. 3). Females can be distinguished by the long, curved, horn-shaped spermathecae, ending in a small rounded tip (Figs 6, 7).

Description of male. *Carapace:* Slightly longer than wide, widest in posterior part, near coxae III. Covered with numerous fine translucent setae and numerous rounded granules, these more visible on ocular spots and margins (Fig. 1). Marginal ocular spots located near to coxae II (Fig. 1). Dorsal depressions on median part, posterior part and near ocular spots (Fig. 1).



FIGURES 1–7. *Pseudocellus cruzlopezi* **sp. nov.**, male holotype (unless otherwise indicated). 1, Habitus, dorsal view; 2, Prosoma, ventral view; 3, Cucullus, dorsal view; 4–5, Right tibia II, dorsal and dorsal-prolateral views respectively; 6, Spermathecae of female paratype, anterior view; 7, Spermathecae of female paratype, posterior view. Scales: 1 mm (Figs. 1–2), 0.5 mm (Figs. 3–5), 0.4 mm (Figs. 6–7).



FIGURES 8–13. *Pseudocellus cruzlopezi* **sp. nov.**, male holotype. 8, Left leg III, metatarsal process, prolateral view; 9, Tarsal claws of leg III; 10, Copulatory apparatus of left leg III, prolateral view (arrows indicate the pores on basal part of metatarsus); 11, Lamina of tarsomere 2 of left leg III, retrolateral view; 12, Tarsal process of copulatory apparatus, apical view; 13, Copulatory apparatus of left leg III, retrolateral view (arrows indicates the pores on basal part of metatarsus). Scales: 100 µm (Figs. 9, 12), 200 µm (Fig. 8, 11), 500 µm (Figs. 10, 13).

Cucullus. Wider than long, widest distally; with numerous rounded granules, more evident than those on carapace. Covered with long and fine translucent setae, longest distally; these setae are longer and thinner than those on carapace (Fig. 3).

Chelicera. Fixed finger with six teeth, the distal longest and the basal shortest. Movable finger with ten teeth, the first four proximal teeth smaller, the fifth tooth longer, and the distal five teeth of medium size.

Sternal region. Coxae I touch the tritosternum at a single point in anterior part; coxae II touch it along anterior fourth. Coxae II considerably larger than others, coxae IV smallest (Fig. 2).

Pedipalp. Trochanter I with rounded granules on ventral-distal half, trochanter II with rounded granules on ventral part. Femur curved, wider proximally than distally, with numerous translucent setae, which are smaller on dorsal part than on ventral part, where there are less. Tibia straight, slightly thinner in middle part; with numerous translucent setae, larger in distal part (Fig. 2).

Legs. With numerous translucent setae on all segments (Figs 1, 4, 5). Femora I–IV with numerous sharp-tipped granules, stronger ventrally. Patella I–IV with numerous rounded granules, stronger on patella II, where they are sharp-tipped. Tibia I with numerous, sharp-tipped granules; tibia II with curved, ventral spines (Figs 1, 4, 5); tibia III ventrally with numerous rounded granules; tibia IV with numerous sharp-tipped granules, weaker than those on tibia I. Metatarsus I with numerous small, sharp-tipped granules on ventral and dorsal parts; metatarsus II with two ventral rows of curved spines and numerous small, sharp-tipped granules on dorsal part (Fig. 1); metatarsus III with numerous rounded granules; metatarsus IV with numerous sharp-tipped granules dorsally and a few rounded granules ventrally.

Copulatory apparatus. Metatarsus conical, short and wide with numerous translucent setae (Figs 10, 13), ventrally with several basal pores (arrows Figs 10, 13); metatarsal process long, dorsally with fine translucent setae (Fig. 8). Tarsal process wide and curved, ending in a long, thin tip (Figs 10, 12). Lamina of tarsomere 2 conical, with translucent setae more numerous and shorter basally (Fig. 11). Tarsomeres with numerous, fine, translucent setae, smaller and more numerous ventrally (Figs 10, 13). Tarsomere 4 with long, curved, paired claws (Figs 9–10, 13).

Opisthosoma. Longer than wide, widest in middle (Fig. 1). Covered uniformly with numerous, fine, translucent setae (Fig. 1). Tergite X–XII wider than long (Fig. 1). Tergite XIII and lateral tergites longer than wide (Fig. 1). All tergites with sparse, rounded granules (Fig. 1). Pygidium with lateral concavities in the third segment.

Coloration. Body reddish (Fig. 1). Carapace, coxae and leg II dark reddish (Figs 1, 2). Opisthosoma darker ventrally than dorsally, with a dark region on sternites XI and XII.

Measurements. Total length (including pygidium) 3.70. Carapace 1.40 long, 1.33 wide. Cucullus 0.56 long, 0.96 wide. Opisthosoma 2.35 long, 1.57 wide. Femur II length/diameter (l/d): 2.56. Legs tarsal formula (leg I to IV): 1-5-4-5. Leg lengths, I: coxa 0.55/ trochanter 1 0.35/ trochanter 2 -/ femur 0.95/ patella 0.46/ tibia 0.70/ metatarsus 0.80/ tarsus 0.36/ total 4.17; II: 0.80/ 0.55/ -/ 1.60/ 0.76/ 1.26/ 1.18/ 1.30/ 7.45; III: 0.65/ 0.38/ 0.50/ 1.02/ 0.55/ 0.65/ 0.72/ 1.12/ 5.59; IV: 0.55/ 0.40/ 0.37/ 1.02/ 0.50/ 0.75/ 0.73/ 0.71/ 5.03. Pedipalp: 0.38/ 0.26/ 0.28/ 0.74 / -/ 1.06/ -/ 0.13/ 2.85. Leg length formula: 2341.

Female. Differs from male as follows: Carapace more rounded. Femur II less robust, 3.7 times longer than wide. Movable finger of chelicera with six teeth, basal tooth longest. Legs with fewer and smaller ventral sharp-tipped granules. The two ventral rows of curved spines on tibia II are smaller than those of male. Opisthosoma wider and longer. Tergites XI and XII wider than those of male. Sternite XIII with lateral concavities.

Measurements: Total length 4.07. Carapace 1.40 long, 1.35 wide. Cucullus 0.60 long, 1.00 wide. Opisthosoma 2.55 long, 1.75 wide. Femur II l/d: 3.60. Legs tarsal formula (leg I to IV): 1-5-4-5. Leg lengths, I: coxa 0.61/ trochanter 1 0.32/ trochanter 2 -/ femur 0.93/ patella 0.45/ tibia 0.66/ metatarsus 0.77/ tarsus 0.38/ total 4.12; II: 0.80/ 0.50/ -/ 1.46/ 0.66/ 1.10/ 1.16/ 1.28/ 6.96; III: 0.66/ 0.37/ 0.36/ 0.95/ 0.52/ 0.65/ 0.70/ 0.63/ 4.84; IV: 0.58/ 0.40/ 0.35/ 1.00/ 0.50/ 0.67/ 0.75/ 0.66/ 4.91; Pedipalp: 0.50/0.30/ 0.27/ 0.76/ -/ 1.13/ -/ 0.13/ 3.09. Leg length formula: 2431.

Tritonymph. Carapace slightly wider than long, with a longitudinal depression on median part; two small rounded depressions on each side, almost on middle part, and several inconspicuous depressions posteriorly. Carapace, cucullus, legs and opisthosoma covered with numerous rounded granules and translucent setae. Femur and tibia of pedipalp without rounded granules. Legs dorsally and ventrally with a conspicuous longitudinal region without granules. Cucullus wider than long, with numerous fine translucent setae, which are longer distally. Opisthosoma longer than wide, tergites X–XII wider than long, tergite XIII as long as wide. Sternites XI–XIII clearly separate, not fused together. Appendages and body coloration pale orange, distal half of pedipalp tibia brownish.

Measurements. Total length 3.50. Carapace 1.20 long, 1.22 wide. Cucullus 0.52 long, 0.82 wide. Opisthosoma 2.50 long, 1.80 wide. Legs tarsal count formula (leg I to IV): 1545.

Related species. *Pseudocellus cruzlopezi* is similar to *P. jarocho* Valdez-Mondragón & Francke 2011 from 5 km East of Tlaquilpa, Veracruz, Mexico. They resemble each other in overall shape, the shape and proportions of femur II in males, and the shape of the ventral spines of tibia II and metatarsus II in the males. However, there are several characters that separate them as different species. *P. jarocho* has the ventral spines of tibia II and metatarsus II longer those of *P. cruzlopezi* (Figs 1, 5). *P. cruzlopezi* has the lamina of tarsomere 2 of leg III distally thinner than that of *P. jarocho* (Figs 11, 13). *P. jarocho* has a basal notch on the lamina of tarsomere 2 that is lacking in *P. cruzlopezi* (Figs 11, 13). Tarsomere 2 is wider in *P. jarocho* than in *P. cruzlopezi* (Fig. 10). The tarsal process of leg III of *P. cruzlopezi* is wide, ending in a long, thin, sharp tip (Figs 10, 12), whereas in *P. jarocho* the tarsal process has two distal tips. *P. cruzlopezi* is smaller: the male holotype has a total length of 4.07 mm, whereas the male of *P. jarocho* has a total length of 5.15 mm. Finally, the spermathecae of *P. cruzlopezi* are long, curved and horn-shaped (Figs 6, 7), whereas in *P. jarocho* they each have a double receptacle, being rounded distally.

Distribution and habitat. This species is known only from the type locality (Fig. 27). The specimens were collected in the ground, under boulders in a tropical rainforest, with a high humidity around 70%, and at an elevation of 943 m.

Pseudocellus monjarazi sp. nov.

Figs. 14–26

Type material. Male holotype (CNAN-T0708), 1 male, 1 female paratypes (CNAN-T0709) from MEXICO: *Chiapas*, Municipio La Trinitaria, Cueva de San Francisco (lat. 16.09971°, long. -92.04690°; alt. 1546 m), 18 June 2011, A. Valdez, O. Francke, C. Santibáñez, J. Cruz, R. Monjaraz, G. Contreras and K. Zárate.

Etymology. The specific name is dedicated to Biol. Rodrigo Monjaraz-Ruedas for his participation in collecting the type series.

Diagnosis. Males can be distinguished by the following combination of characters: tarsal process of leg III ending in a wide tip, with two small, sub-apical, conical projections (Fig. 25, arrowed); metatarsal process long and hook-shaped (Figs 21, 23); lamina of tarsomere 2 long and thin, with a marked concavity basally (Fig. 24); and the oval shape of the cucullus, which is rounded laterally (Fig. 16). Females can be distinguished by the spermathecae, each having an oval lobule and an elongate lobule (Figs 19, 20).

Description of male. *Carapace:* Slightly longer than wide; widest posteriorly, at level of coxae III (Fig. 14). Ocular spots long, between level of coxae II and III (Fig. 14). Covered with rounded granules, more numerous in the dorsal depressions, one of which is located on median part and the others near to ocular spots and on posterior part of carapace (Fig. 14). Covered with fine translucent setae (Fig. 14).

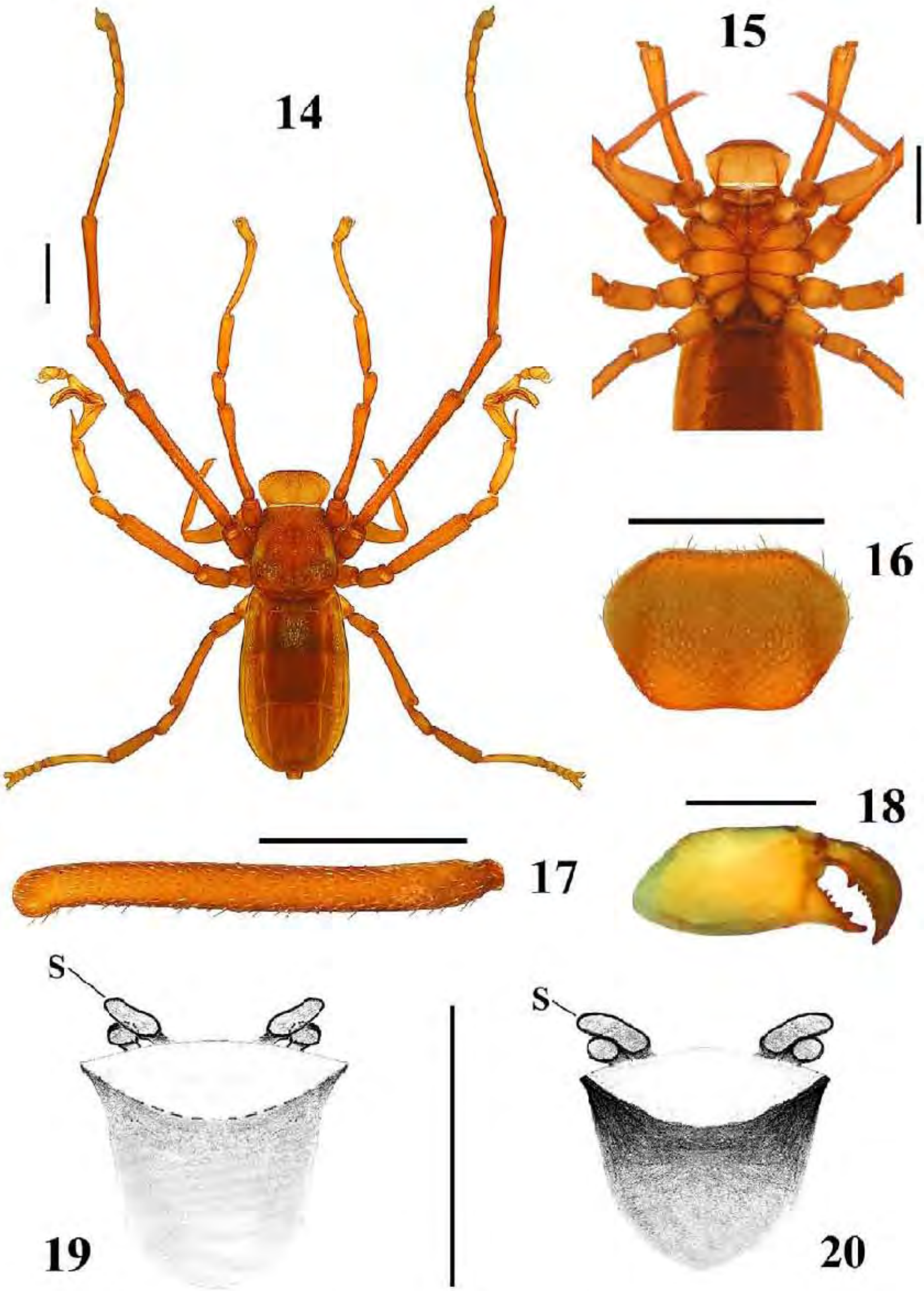
Cucullus. Wider than long, widest distally. Covered with long, fine translucent setae, which are longer distally. Covered with numerous rounded granules, most evident distally (Fig. 16).

Chelicera. Fixed finger with five teeth, distal tooth longer than others (Fig. 18). Movable finger broad, with seven teeth, basal tooth longer than others.

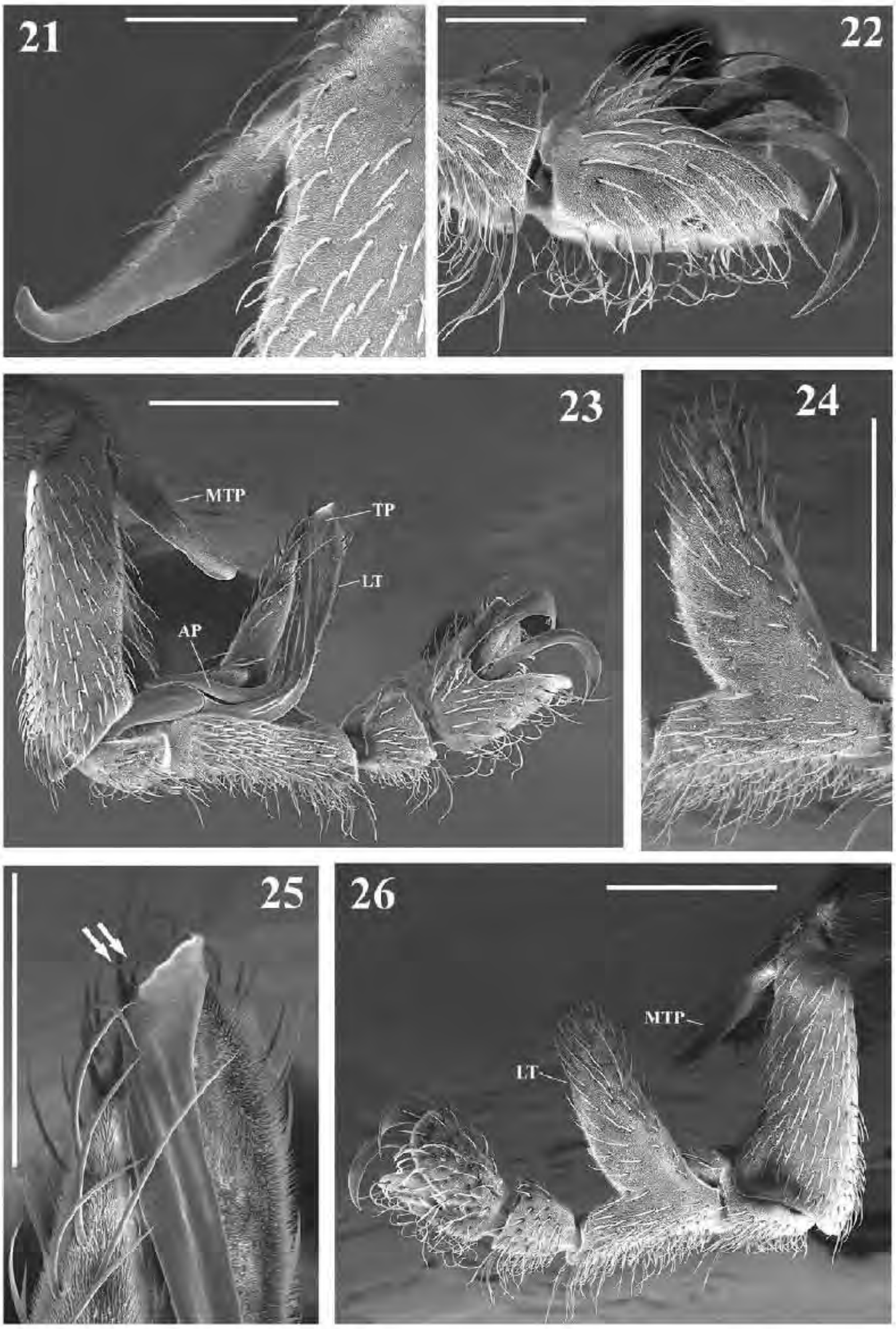
Sternal region. Tritosternum almost rounded, touched by coxae of pedipalp and legs I and II. Coxa II considerably larger than the others, coxa IV smallest (Fig. 15).

Pedipalp. Trochanters I and II with sparse, rounded granules ventrally. Femora curved, without rounded granules; with numerous translucent setae, smaller dorsally, and less numerous, longer and thinner ventrally (Fig. 15). Tibiae slightly wider basally than distally; with numerous translucent setae, longer distally (Fig. 15).

Legs. Long (Fig. 14), with numerous translucent setae on all segments (Figs 14, 17). Femora long and thin, with numerous granules. Femur I curved on prolateral part (Fig. 14), femur III curved ventrally, femora II and IV straight. Patellae with numerous rounded granules; patella II considerably longer than the others (Fig. 14). Tibiae with numerous rounded granules (Fig. 17). Metatarsi with some rounded granules; metatarsus I much longer and thinner than the others; metatarsus III shorter than the others (Fig. 14).



FIGURES 14–20. *Pseudocellus monjarazi* **sp. nov.**, male holotype (unless otherwise indicated). 14, Habitus, dorsal view; 15, Prosoma, ventral view; 16, Cucullus, dorsal view; 17, Right tibia II, dorsal view; 18, Left chelicera, dorsal view; 19, Spermathecae of female paratype, anterior view; 20, Spermathecae of female paratype, posterior view. Scales: 1 mm (Figs. 14–17), 0.4 mm (Figs. 19–20), 0.5 mm (Fig. 18).



FIGURES 21–26. *Pseudocellus monjarazi* **sp. nov.**, male holotype. 21, Metatarsal process of leg III, retrolateral-ventral view; 22, Tarsal claws of leg III; 23, Copulatory apparatus of left leg III, prolateral view; 24, Lamina of tarsomere 2 of left leg III, retrolateral view; 25, Tarsal process of copulatory apparatus, apical view (arrows indicate the two small sub-apical conical projections); 26, Copulatory apparatus of left leg III, retrolateral view. Scales: 200 µm (Fig. 21, 22, 25), 500 µm (Figs. 23–24, 26).

Copulatory apparatus. Metatarsus rectangular in prolateral view (Fig. 23), broadened distally in retrolateral view (Fig. 26); with numerous curved translucent setae (Figs 23, 26). Metatarsal process long and curved, with curved translucent setae dorsally on basal half (Fig. 21). Tarsal process curved, ending in a wide tip (Figs 23, 25). Lamina of tarsomere 2 with numerous curved translucent setae, more abundant and longer distally (Fig. 24). Tarsomere 2 with numerous conspicuous curved translucent setae (Fig. 24). Tarsomere ventrally with numerous, long and curved translucent setae (Figs 23, 24, 26). Tarsomere 4 with paired, long, curved claws (Fig. 22).

Opisthosoma. Longer than wide, widest in middle (Fig. 14). Covered with numerous, fine, translucent setae and some rounded granules (Fig. 14). Tergites X–XII wider than long (Fig. 14). Tergite XIII and lateral tergites longer than wide (Fig. 14). Pygidium longer ventrally than dorsally, with small lateral concavities in third segment.

Coloration. Body brownish (Fig. 14). Carapace and legs II dark brownish (Fig. 14). Opisthosoma with sternites XI and XII reddish in median part (Fig. 14).

Measurements. Total length (including pygidium) 4.90. Carapace 1.63 long, 1.53 wide. Cucullus 0.76 long, 1.16 wide. Opisthosoma 3.55 long, 1.95 wide. Femur II length/diameter: 9.38. Legs tarsal formula (leg I to IV): 1-5-4-5. Leg lengths, I: coxa 0.78/ trochanter 1 0.50/ trochanter 2 -/ femur 1.83/ patella 0.70/ tibia 1.16 / metatarsus 1.43/ tarsus 0.60/ total 7.00; II: 0.90/ 0.70/ -/ 3.00/ 1.35/ 2.42/ 2.35/ 2.25/ 12.97; III: 0.70/ 0.53/ 0.70/ 1.90/ 0.80/ 0.97/ 0.96/ 1.30/ 7.86; IV: 0.63/ 0.62/ 0.58/ 1.95/ 0.80/ 1.10/ 1.20/ 1.05/ 7.93. Pedipalp: 0.65/ 0.42/ 0.53/ 1.06/ -/ 1.50/ -/ 0.20/ 4.36. Leg length formula: 2431.

Variation. Male holotype darker than male paratype. Opisthosoma of paratype without reddish pattern on sternites XI and XII. Movable finger of chelicerae with six teeth in paratype. Paratype with ocular spots wider than those of holotype. Paratype with paired lines on tergites XII–XIII, dark and slender. Measurements of the paratype: total length: 5.20, cucullus width 1.16, carapace width 1.56, opisthosoma length 3.42, width 2.05, femur II l/d: 8.85.

Female. Differs from males as follows. Carapace shorter, with ocular spots more obvious. Body coloration darker. Opisthosoma larger. Tergites XI and XII wider. Sternites XI?XIII with paired sclerotized lines.

Measurements. Total length 5.00. Carapace 1.55 long, 1.60 wide. Cucullus 0.80 long, 1.15 wide. Opisthosoma 3.60 long, 2.25 wide. Femur II length/diameter (l/d): 10.00. Leg tarsal formula (leg I to IV): 1-5-4-5. Leg lengths, I: coxa 0.80/ trochanter 1 0.46/ trochanter 2 -/ femur 1.76/ patella 0.66/ tibia 1.15/ metatarsus 1.42/ tarsus 0.60/ total 6.85; II: 0.90/ 0.65/ -/ 2.92/ 1.36/ 2.25/ 2.25/ 2.25/ 12.58; III: 0.73/ 0.53/ 0.60/ 2.00/ 0.76/ 1.15/ 1.10/ 1.00/ 7.87; IV: 0.66/ 0.58/ 0.56/ 2.00/ 0.85/ 1.20/ 1.21/ 1.10/ 8.16. Pedipalp: 0.66/ 0.56/ 0.40/ 1.16/ -/1.66/ -/ 0.22/ 4.66. Leg length formula: 2431.

Related species and remarks. *Pseudocellus monjarazi* generally resembles *Pseudocellus bolivari* (Gertsch, 1971) from Sumidero del Camino, 16 Km NE of Comitán, Chiapas, México, located about 40 km from the type locality of *P. monjarazi*. However, there are several morphological characters that separate them. First, *P. bolivari* is larger than *P. monjarazi*: the total length of *P. bolivari* is 6.5 mm, whereas *P. monjarazi* is 4.90 mm long (Fig. 14). *P. bolivari* is reddish in general body coloration, whereas *P. monjarazi* is brownish (Figs 14–17). *P. bolivari* has legs wider than those of *P. monjarazi*, with the femora of legs III and IV being notably wider (ratios 3.4 and 3.3) than those of *P. monjarazi* (ratios 5.0 and 7.0) (Fig. 14). *P. bolivari* has the tarsal claws asymmetrical, with some being spatulate (Gertsch, 1971: figs 5, 6), whereas *P. monjarazi* only has symmetrical claws, which are never spatulate (Figs 22–23, 26). *P. bolivari* has the fixed finger of the chelicera with four teeth of different sizes, whereas *P. monjarazi* has five teeth, with the distal tooth longer than the others (Fig. 18). The tarsal process of leg III of *P. bolivari* is trifurcate at the apex, whereas in *P. monjarazi* it has a wide tip with two small, sub-apical, conical projections (Figs 23, arrows 25). *P. monjarazi* has the lamina of tarsomere 2 of leg III thinner than *P. bolivari* (Fig. 24). Finally, the shape of the spermatheca is very different: in *P. bolivari* the two lobules on each side are both rounded, with one larger than the other, whereas in *P. monjarazi* only one lobule is oval and the other is long and finger-shaped (Figs 19–20).

Gertsch (1971), in the description of *P. bolivari*, mentioned a male collected from Grutas de Zapaluta, as being a morphological variation of *P. bolivari*, but based on its description, it instead corresponds to *P. monjarazi*.

Distribution and habitat. Known from the type locality in Chiapas, Mexico, and Grutas de Zapaluta, 6.5 km NE of Zapaluta (Gertsch 1971) (Fig. 27). The types of *Pseudocellus monjarazi* were collected approximately 120 m inside this horizontal cave, in karstic terrain located in a moderately disturbed oak forest. They were found on the walls of a narrow passage with a low oxygen concentration. The humidity inside the cave was around 70%. The cave shows a high degree of human disturbance, because people from the nearby town hold religious ceremonies inside the cave. Inside the cave there is a river that has been contaminated by the town's sewage.

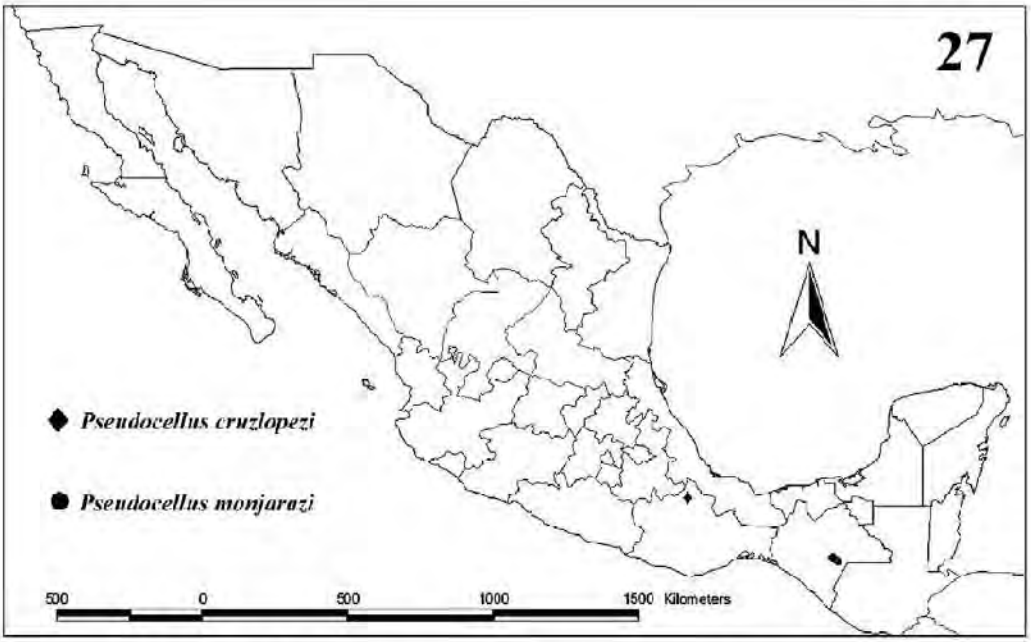


FIGURE 27. Distribution records of *Pseudocellus cruzlopezi* and *Pseudocellus monjarazi*.

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Morphological phylogenetic analysis of the spider genus *Physocyclus* (Araneae: Pholcidae)

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Abstract. With 30 species and a natural distribution in North America, 28 confined to Mexico, *Physocyclus* Simon 1893 is the most diverse genus within the pholcid spider subfamily Arteminae. This paper provides the first phylogenetic test of the genus's monophyly through a cladistic analysis of 54 morphological characters using equal and implied weighting. The equally weighted analysis found 12 most parsimonious trees, whereas the analysis with implied weights varying the concavity values ($K = 6$–10) found five or six most parsimonious trees. The monophyly of the genus *Physocyclus* is supported by three synapomorphies: 1) the paired ventral apophysis on the anterior part of the epigynum; 2) the lateral constraints in the middle part of the epigynum; and 3) the arc of the uterus, with a single sclerotized projection on the anterior part. The genus *Physocyclus* contains two clades treated as species groups: the *globosus* group, with 11 species, and the *dugesi* group with 19 species. The species relationships within the *globosus* group were better resolved than those in the *dugesi* group. The *globosus* group has a biogeographical distribution pattern in the Mesoamerican and Mexican Mountain biotic components, whereas the *dugesi* group has a distribution pattern in the Mesoamerican and Continental Nearctic biotic components. Given the complex biogeography in Mexico, apparently a large-scale vicariant event separated the two major clades within the genus *Physocyclus*.

Keywords: Cladistic analyses, morphology, species groups

The spider family Pholcidae ranks among the most diverse of web-building spider families, currently with 90 genera and 1330 species (Platnick 2013). These spiders are found in temperate, tropical and subtropical forests, with numerous synanthropic species and often in geographic areas and habitats that are severely threatened by human activity (Huber 2000, 2011b). In the New World, a great number of species remain unknown (Gertsch 1982; Huber 1997, 1998, 2000). Huber's (2000) paper is the most complete work for the New World pholcids, particularly from South America. For North America, including Mexico, the principal taxonomic contributions were made by Gertsch (1971, 1973, 1982), Gertsch and Davis (1937, 1942), and Gertsch and Mulaik (1940). Lately, the most recent important taxonomic contributions for North America were made by Slowik (2009) with the taxonomic revision of the genus *Psilochorus* Simon 1893 and Valdez-Mondragón (2010, 2013) with the taxonomic revisions of *Physocyclus* Simon 1893 and *Ixchela* Huber 2000, respectively. Huber (2000) described and redescribed some genera and new species from Mexico. The description of *Modisimus deltoroi* by Valdez-Mondragón and Francke (2009), and the taxonomic revisions of Valdez-Mondragón (2010, 2013), have been the latest taxonomic contributions made for Mexican pholcids. Currently, there has been considerable progress in the knowledge of pholcids from Mexico, with 13 genera and 162 species known.

Despite numerous recent revisions, the diversity of pholcid spiders in the New World is still inadequately known, and many species await description, mostly from previously underrepresented regions of Central and North America (Huber 2000). In Brazil, for example, no fewer than 39 new species were found in the Atlantic Forest (Huber & Rheims 2011), it being one of the most diverse areas in the country. Considerable fieldwork and research at biological collections where many specimens are deposited, not only from Mexico but also from the rest of Central and North America, are also necessary. For example, Valdez-Mondragón (2013) described 10 new species of the genus *Ixchela* Huber 2000 from Mexico and Honduras, and another five are currently being described (A. Valdez-Mondragón unpubl.).

Huber (2011a) divided the family Pholcidae into five subfamilies based on previous cladistic analyses of morphological and molecular data and on qualitative character assessment (Huber 2000; Bruvo-Madarić et al. 2005; Astrin et al. 2006): Ninetinae Simon 1890, Arteminae Simon 1893, Modisiminae Simon 1893, Smeringopinae Simon 1893 and Pholcinae C.L. Koch 1850. Currently, the genus *Physocyclus* is placed within the subfamily Arteminae, which includes 77 species in five genera, with *Physocyclus* and *Trichocyclus* Simon 1908 being the most diverse genera, containing 30 and 23 species respectively (Valdez-Mondragón 2010; Huber 2011a; Platnick 2013). Phylogenetic evidence, both morphological and molecular, suggests a close relationship of *Physocyclus* with *Artema* and *Trichocyclus* (Bruvo-Madarić et al. 2005; Huber 2011a), and the most recent molecular work hypothesizes a sister relationship of *Physocyclus* and *Artema*, a genus distributed in the Middle East (Dimitrov et al. 2013).

The monophyly of *Physocyclus* has never been tested, but now the taxonomic revision of the genus (Valdez-Mondragón 2010), where 13 new species were described, facilitates an analysis of morphological characters based mainly on the homologies within male chelicerae and female epigyna. The primary objective of the present paper is to test the monophyly of the genus and establish the internal relationships among the species through the first cladistic analysis of the genus *Physocyclus*.

METHODS

Biological material.—The specimens used in this study were the same as those examined by Valdez-Mondragón (2010) and are deposited in the following collections: Colección Nacional de Arácnidos (CNAN), Instituto de Biología, Universidad Nacional Autónoma de México, México; Universidad Michoacana de San Nicolás de Hidalgo (UMSNH), Morelia, Michoacán, México; Centro de Investigaciones Biológicas del Noroeste (CIBNOR), Baja California Sur, México; American Museum of Natural History (AMNH), New York, New York, USA; Texas Memorial Museum (TMM-UT), University of Texas, Austin, Texas, USA; Instituto Nacional de Biodiversidad (INBio), Santo Domingo de Heredia, Costa Rica and Western Australian Museum (WAM), Welshpool, Australia. Other institutions mentioned: California Academy of Sciences (CAS), San Francisco, California, USA; Museum of Comparative Zoology (MCZ), Cambridge, Massachusetts, USA and Muséum National d'Histoire Naturelle, (MNHN) Paris, France. I examined and photographed the specimens with a Nikon SMZ645 stereoscope, following Valdez-Mondragón (2013). The photographs were taken with a Nikon Coolpix S10 VR camera with adapter for the microscope. I used ArcView GIS version 3.2 (Applegate 1999) to prepare distribution maps and edited both the photographs and maps using Adobe Photoshop Version 7.0. Abbreviations used in the figures: E, embolus; ES, embolic sclerites; LAC, lateral apophysis of chelicerae; PP, pore plates; SF, stridulatory files and VAE, ventral apophyses of epigynum.

Taxon sampling.—The cladistic analysis was based on 33 taxa. The ingroup included 29 species of *Physocyclus*. *Physocyclus mexicanus* Banks 1898 was not included in the analysis because this species is known only from the female holotype, which was not examined. *Physocyclus viridis* Mello-Leitão 1940 (insertae sedis) is known only from the male holotype; however, the characters of the original description seem to belong to another genus and not to *Physocyclus* (Valdez-Mondragón 2010), and furthermore the male holotype is lost (B.A. Huber, pers. comm.). The outgroups included *Priscula binghamae* (Chamberlin 1916), *Trichocyclus nigropunctatus* Simon 1908, *Trichocyclus nullarbor* Huber 2001 and *Artema atlanta* Walckenaer 1837. They were selected based on previous phylogenetic relationships with the family Pholcidae (Huber 2000; Bruvo-Madarić et al. 2005; Astrin et al. 2006; Huber 2011a). The trees were rooted on *P. binghamae*, selected because it belongs to the subfamily Modisiminae, which is phylogenetically related to Arteminae (Huber 2011a).

Character matrix.—The character matrix comprised 54 morphological characters, of which 44 were binary and 10 were multistate (Appendix). Forty-seven characters were informative and seven were uninformative, but they were retained in the matrix because they can potentially contribute to future morphological analyses or taxonomic identification keys. Only the important characters used to diagnose the genus *Physocyclus* and the species groups have been illustrated; for all other characters in the genus *Physocyclus* a recent revision should be consulted (Valdez-Mondragón 2010). In the analyses with equal weighting, I deactivated uninformative characters so as not to inflate the tree length and consistency index (CI). The matrix was maintained in WinClada-Asado, version 1.7 (Nixon 2004). I treated multistate characters as non-additive (Fitch 1971).

Cladistic analysis.—The cladistic analysis with equal weighting was run using Heuristic Search under NONA version 1.8 (Goloboff 1993a) and TNT (Goloboff et al. 2008). In NONA, I conducted the analysis with equal weighting using the following commands: Max trees to keep (hold) = 10,000; No. of replications (mult*N) = 1000; Starting trees per replicate (hold/) = 50; using Multiple TBR+TBR (mult*max*). Under TNT, I conducted the analysis with the following commands: Wagner trees: Random seed = 100; Repls. (Number of add. seqs.) = 10,000; Swapping algorithm: Tree Bisection and Reconnection (TBR); trees to save per replication = 100.

I carried out implied character weighting analyses (Goloboff 1993b, 1995) to assess the effects of weighting against homoplastic characters. In TNT, the analysis with implied weighting was conducted using a traditional search with the following commands: Starting trees (Wagner trees): Random seed = 100; No. of replications = 1000; swapping algorithm (TBR); trees to save per replication = 100. Ten arbitrary values for the concavity constant were used: $K = 1$–10.

Branch support was calculated using Jackknife (Farris et al. 1996) under TNT (Goloboff et al. 2008) and the command: Number of replicates = 1000, removal probability = 36%, using traditional search, and Bremer support (Bremer 1988) under TNT, retain trees suboptimal by 5 steps.

I resolved ambiguous character optimizations with accelerated transformation (ACCTRAN) (Farris 1970; Swofford & Maddison 1987; Agnarsson & Miller 2008). The trees were edited in WinClada and Adobe Photoshop 7.0.

RESULTS

Heuristic equal weighting searches in NONA and TNT found 12 most parsimonious cladograms (L = 127, CI = 70, RI = 85). Figure 1 shows the strict consensus of the minimum length trees in which six nodes collapsed. The cladistic analysis supports the monophyly of the genus *Physocyclus* Simon 1893 with high Jackknife and Bremer values (Fig. 1), and the genus is supported by three synaphomorphies (char. 7, 8, 12) (see discussion for character states). The analysis found two clades within the genus *Physocyclus*, considered as species groups and supported with high Jackknife and Bremer values (Fig. 1). The *globosus* species group consists of 11 species, and the *dugesi* group consists of 19 species (Fig. 1).

The monophyly of the *globosus* group is supported with high Jackknife and Bremer values of 74% and 4 respectively, and by five synapomorphies (Fig. 1): 1) the posterior dorsal sclerotized protuberance on carapace of the female (char. 3) (right arrow, Fig. 14); 2) the sclerotized patch on dorsal anterior part on the female opisthosoma (char. 4) (left arrow, Fig. 14); 3) the short, wide, and oval-shaped pore plates in the epigynum (char. 10, character state 2) (Figs. 17, 21); 4) the dorso-distal spine on the embolus (char. 30) (arrow, Fig. 19) and 5) the embolic sclerites positioned dorsally on the embolus (char. 37) (left arrow, Fig. 15). The monophyly of the *dugesi* group is supported with high Jackknife and Bremer support values of 82% and 5 respectively, and by four synapomorphies (Fig. 1): 1) the lateral constraints in middle part of the epigynum are very marked and bell-shaped (char. 9, character state 1) (arrow, Fig. 2), 2) the embolic sclerites on retrolateral part of the bulb (char. 43) (left arrow, Fig. 8), 3) the notch between embolic sclerites and embolus (char. 45) (middle arrow, Fig. 6) and 4) by having > 30 sclerotized cones frontally on male chelicerae (except *P. platnicki* Valdez-Mondragón 2010, Fig. 197) (char. 23, character state 1) (Figs. 5, 9).

The analyses with implied weighting, using ten different concavity values (*K*), also supported the monophyly of the

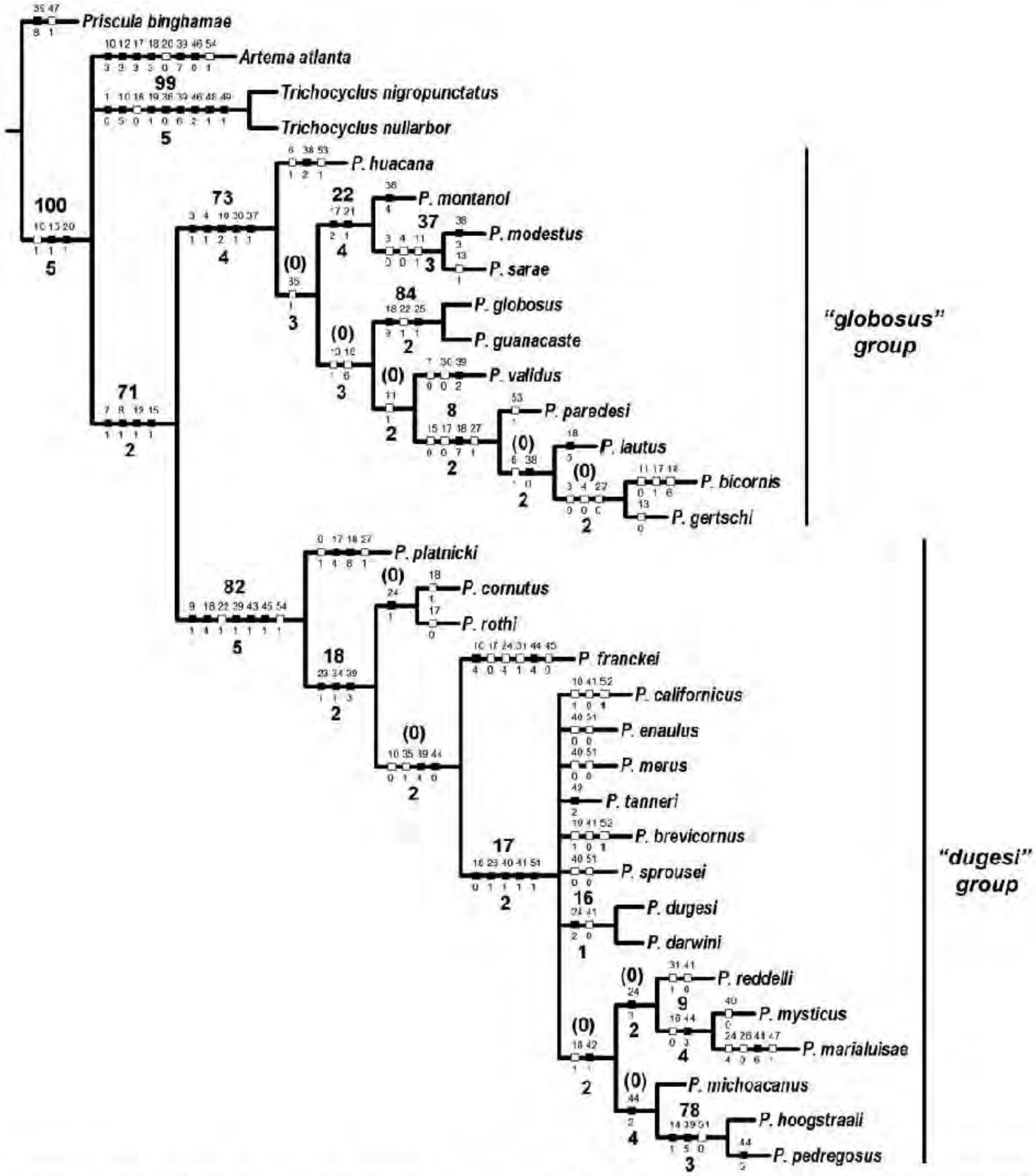
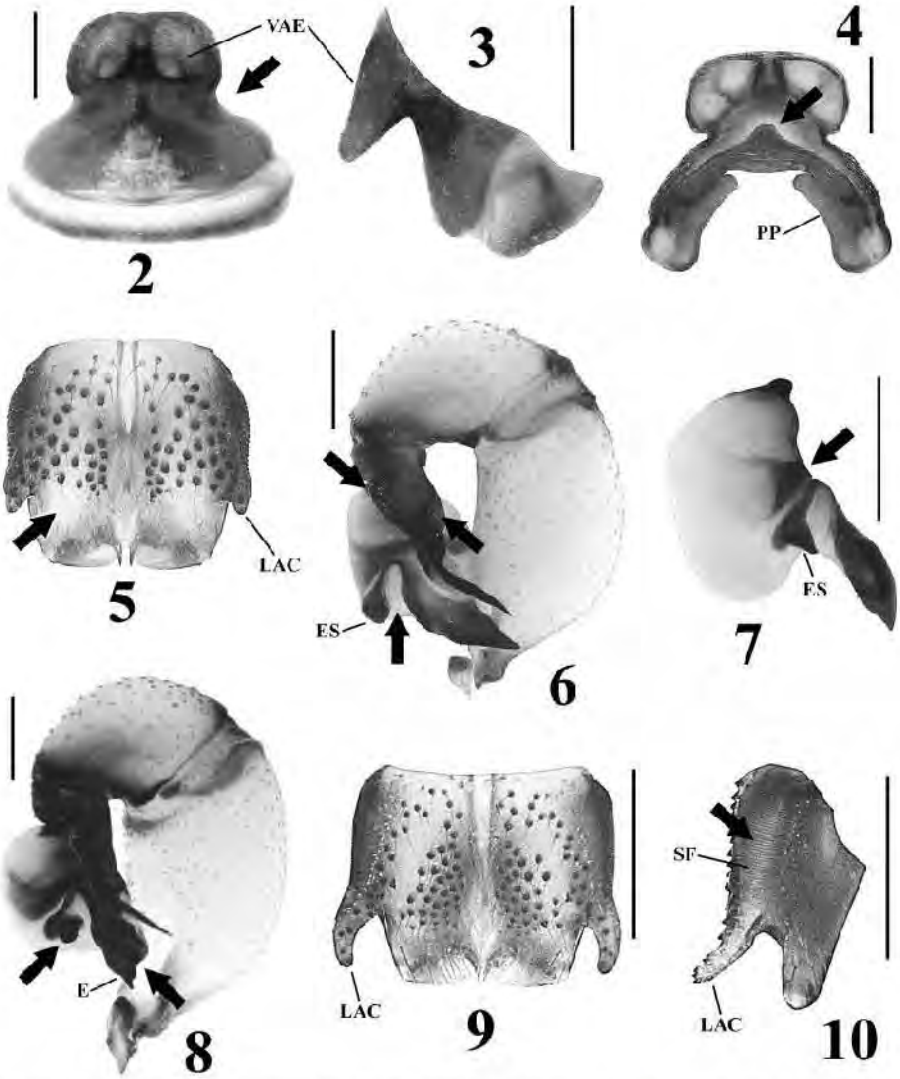


Figure 1.—Strict consensus trees of 12 most parsimonious trees obtained by cladistic analysis with equal weighting of characters under NONA (L = 127, CI=70, RI= 85). Black bars indicate unreversed synapomorphic or apomorphic states, and white bars indicate homoplastic characters. Small numbers above bars indicate character number; small numbers below bars indicate character state. Larger numbers above branches indicate Jackknife support values; larger numbers below branches indicate Bremer support values; (0) above nodes indicate unsupported or collapsed nodes with Jackknife.



Figures 2–10.—*Physosyclus cornutus*: **2, 3**. Epigynum, ventral and lateral view respectively (arrow indicates lateral constraints in middle part). *P. michoacanus*: **4**. Epigynum, dorsal view (arrow indicates the single sclerotized projection on the arc). *P. dugesi*: **5**. Chelicerae, frontal view (arrow indicates the pale concavity on each chelicerae); **6**. Left palp, retrolateral view (left arrow indicates dorsal apophysis of procursus; middle arrow indicates the notch between embolic sclerites and embolus; right arrow indicates the ventral notch of the procursus); **7**. Bulb of the left palp, dorsal view (arrow indicates the sclerotized retrolateral region strongly visible). *P. sporusei*: **8**. Left palp, retrolateral view (left arrow indicates the embolic sclerites, right arrow indicates the apical ventral concavity). *P. reddelli*: **9, 10**. Chelicerae, frontal and lateral views, respectively (arrow indicates the stridulatory file). Scale bars: 0.5 mm.

genus *Physocyclus*, with Jackknife values of ≥ 70 (Table 1). The analyses with concavity values ($K = 6$–10) obtained fewer parsimonious trees (5 or 6) of the same length as the analysis of equal weighting (Table 1). The analyses with the highest fit values ($K = 9, 10$) recovered only five parsimonious trees, with the same CI and RI values of the equally weighted trees (Table 1), and the strict consensus found the same topology as with equal weighting (Fig. 1).

Morphological characters.—The morphological characters used in the phylogenetic analysis [54 characters (44 binary and 10 multistate)] are listed below; some characters are described in Valdez-Mondragón (2010), which is abbreviated in this part as VM (2010):

Prosoma:

1. Anterior median eyes, diameter: (0) > diameter of anterior lateral eyes, (1) < diameter of anterior lateral eyes
2. Fovea, shape: (0) point-shaped, (1) longitudinal
3. Carapace of female, posterior dorsal sclerotized protuberance (arrow, Fig. 14): (0) absent, (1) present

Table 1.—Summary of the phylogenetic hypotheses among the most parsimonious trees (MPT) found with equal weighting (EW) and implied weighting (IW), with 10 values for the concavity constant (*K*), arranged in order of increasing fit (*fi*). CI= Consistency index, RI= Retention index, J= Jackknife values that support the monophyly of *Physocyclus* in the different hypothesis.

Analyses	MPT	Steps	fit (*fi*)	CI	RI	Status of *Physocyclus*
IW: *K*= 1	42	133	33.52	67	82	J= 70 (monophyletic)
IW: *K*= 2	14	128	36.97	70	84	J= 71 (monophyletic)
EW	12	127	38.90	70	85	J= 72 (monophyletic)
IW: *K*= 3	14	128	39.10	70	84	J= 72 (monophyletic)
IW: *K*= 4	14	128	40.48	70	84	J= 73 (monophyletic)
IW: *K*= 5	14	128	41.44	70	84	J= 74 (monophyletic)
IW: *K*= 6	5	127	42.17	70	85	J= 74 (monophyletic)
IW: *K*= 7	6	127	42.73	70	85	J= 75 (monophyletic)
IW: *K*= 8	6	127	43.17	70	85	J= 75 (monophyletic)
IW: *K*= 9	5	127	43.53	70	85	J= 75 (monophyletic)
IW: *K*= 10	5	127	43.83	70	85	J= 76 (monophyletic)

Opisthosoma:

4. Opisthosoma of female, sclerotized patch, on dorsal anterior part (arrow, Fig. 14): (0) absent, (1) present
5. Epigynum, distal paired apophysis, next to epigastric furrow: (0) absent, (1) present
6. Epigynum, two small median U-shaped concavities (VM 2010; Figs. 67, 144): (0) absent, (1) present
7. Epigynum, paired ventral apophysis on anterior part (Figs. 2, 3, 11, 20): (0) absent, (1) present
8. Epigynum, lateral constraints in middle part (Figs. 2, 20): (0) absent, (1) present
9. Epigynum, lateral constraints in middle part, shape: (0) barely visible, inconspicuous (Fig. 20); (1) very marked, bell-shaped (arrow, Fig. 2)
10. Epigynum, pore plates, shape: (0) very long and thin (Fig. 4); (1) long and wide (VM 2010; Figs. 13, 20); (2) short, wide, oval-shaped (Fig. 17); (3) short and thin; (4) triangular; (5) short and curved
11. Pore plates, structures bag-shaped below them (arrow, Fig. 21): (0) absent, (1) present
12. Epigynum, sclerotized arc, dorsal view: (0) without sclerotized projection on anterior part, (1) with a sclerotized projection on anterior part (arrows, Figs. 4, 17), (2) with two sclerotized projections on anterior part
13. Epigynum, dorsal arc surrounding pore plates (Fig. 17): (0) absent, (1) present
14. Epigynum, median protuberances, laterally (VM 2010; Figs. 60, 95): (0) absent, (1) present

Legs:

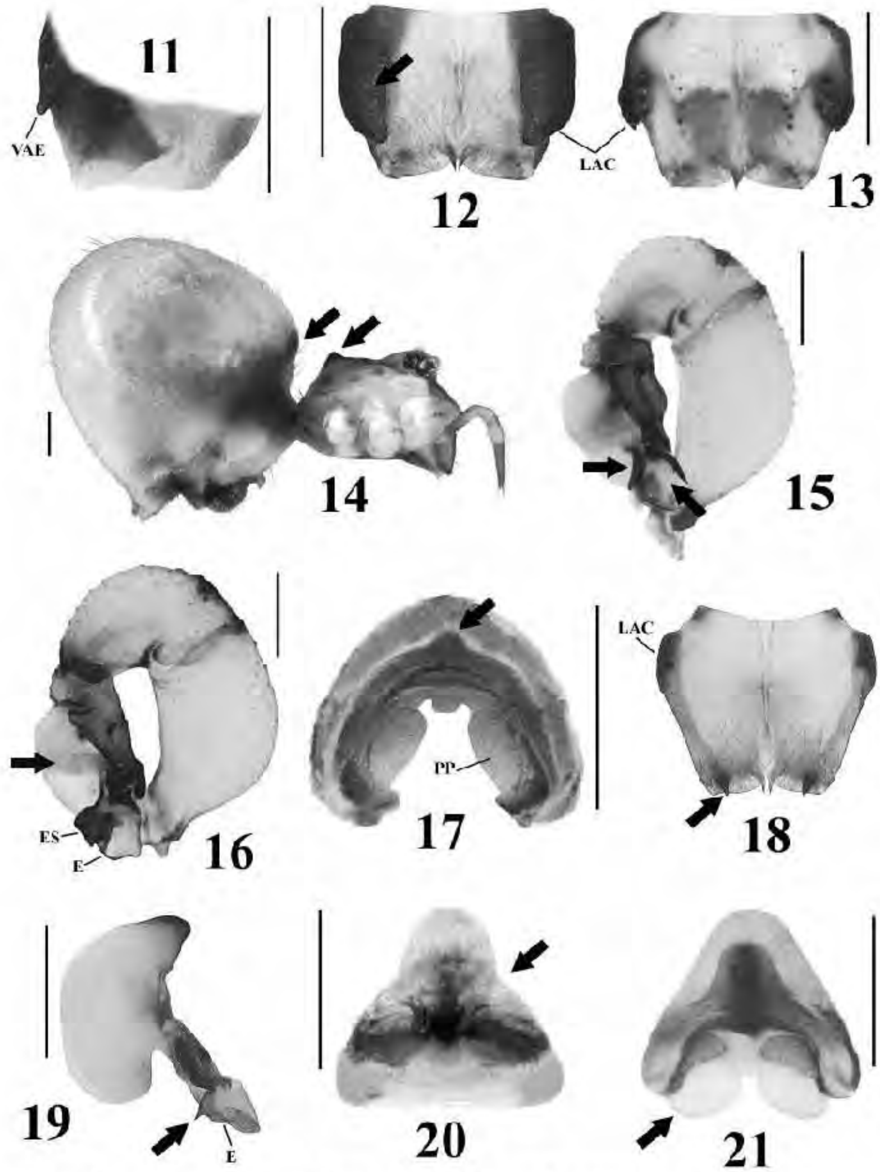
15. Legs, curved setae in tibiae and metatarsi: (0) absent; (1) present

Chelicerae:

16. Chelicerae of male, lateral apophysis (Figs. 5, 9, 12, 13): (0) absent, (1) present
17. Chelicerae of male, lateral apophysis, location: (0) proximal (Fig. 18), (1) middle part (Fig. 5), (2) frontal-retrolateral (arrow, Fig. 12), (3) along, (4) distally (VM 2010; Fig. 197)
18. Chelicerae of male, lateral apophysis, shape: (0) small and conical (Fig. 5), (1) conical and long (Figs. 9, 10), (2) shield-shaped (Fig. 12), (3) wide and along, (4) wide and projected toward front (VM 2010; Fig. 183), (5) small and triangular (Fig. 18), (6) wide and triangular in lateral view (VM 2010; Figs. 2, 113), (7) wide and with two projections in lateral view (VM 2010; Fig. 141), (8) small, with several cones distally (VM 2010; Figs. 197, 198), (9) small and with irregular shape (Fig. 13)
19. Chelicerae of male, frontal curved apophysis, basally: (0) absent, (1) present
20. Chelicerae of male, stridulatory files laterally (arrow, Fig. 10): (0) absent, (1) present
21. Chelicerae of male, discontinuous files frontally: (0) absent, (1) present, on wide apophysis shield-shaped (arrow, Fig. 12)
22. Chelicerae of male, sclerotized cones frontally (Figs. 5, 9): (0) absent, (1) present
23. Chelicerae of male, sclerotized cones frontally, number on each chelicerae: (0) < 20 cones (Fig. 13), (1) > 30 cones (Figs. 5, 9)
24. Chelicerae of male, > 30 sclerotized cones frontally, position: (0) on basal half, and on prolateral part of chelicerae and lateral apophysis (VM 2010, Fig. 8); (1) on basal half, and on prolateral part of chelicerae and lateral apophysis, leaving a basal zone on prolateral part without cones (VM 2010, Fig. 15); (2) on ¾ of total length, and on prolateral part of chelicerae and lateral apophysis (Fig. 5); (3) on prolateral part, and toward prolateral part of lateral apophysis leaving an area with half-moon shape without cones between them (Fig. 9); (4) scattered throughout (VM 2010; Fig. 119)
25. Chelicerae of male in frontal part, pale basal half and brown distal half (Fig. 13): (0) absent, (1) present
26. Chelicerae of male, pale concavity on each chelicera (arrow, Fig. 5): (0) absent, (1) present
27. Chelicerae of male, frontal distal small apophysis, conical (arrow, Fig. 18): (0) absent, (1) present
28. Chelicerae of male, retrolateral frontal apophysis, near to the fangs (*Priscula binghamae*): (0) absent, (1) present

Palps:

29. Procursus, dorsal apophysis and ventral notch basally (left and right arrows respectively, Fig. 6): (0) absent, (1) present



Figures 11–21.—*Physocyclus modestus*: **11.** Epigynum, lateral view; **12.** Chelicerae, frontal view (arrow indicates the frontal-retrolateral apophysis on chelicerae). *P. guanacaste*: **13.** Chelicerae, frontal view. *P. globosus*: **14.** Female habitus, lateral view (left arrow indicates the sclerotized patch on dorsal part of opisthosoma, right arrow indicates the posterior dorsal sclerotized protuberance on carapace); **15.** Left palp, retrolateral view (left arrow indicates the embolic sclerites, right arrow indicates the brush of pseudotrichia on procursus). *P. bicornis*: **16.** Left palp, retrolateral view (left arrow indicates the inconspicuous sclerotized retrolateral region on palp bulb); **17.** Epigynum, dorsal view (arrow indicates the single sclerotized projection on the arc). *P. lautus*: **18.** Chelicerae, frontal view (arrow indicates frontal distal small apophysis); **19.** Bulb of the left palp, dorsal view (arrow indicates the dorso-distal spine on embolus). *P. sarae*: **20.** Epigynum, ventral view (arrow indicates lateral constraints in middle part); **21.** Epigynum, dorsal view (arrow indicates the bag-shaped structures below the pore plates). Scale bars: 0.5 mm.

30. Embolus, dorso-distal spine (arrow, Fig. 19): (0) absent, (1) present
31. Femora of male palp, small prolateral ventral apophysis, with cone-shaped (VM 2010; Fig. 121): (0) absent, (1) present
32. Femora of male palp, prolateral ventral apophysis, distally, oval with flat tip: (0) absent, (1) present
33. Femora of male palp, large ventral conical projection (VM 2010; Fig. 86): (0) absent, (1) present

34. Bulb, sclerotized retrolateral region: (0) absent or inconspicuous (arrow, Fig. 16), (1) strongly visible (arrow, Fig. 7)
35. Procursus, large distal spine (Figs. 6, 8, 15): (0) absent, (1) present
36. Procursus, brush of pseudotrichia distally (right arrow, Fig. 15): (0) absent, (1) present
37. Embolus, embolic sclerites dorsally (left arrow, Fig. 15): (0) absent, (1) present
38. Embolus, embolic sclerites dorsally, shape: (0) large and wide, on almost total length of embolus (VM 2010; Fig. 65); (1) small, on almost total length of embolus, without notch on median part (Fig. 15); (2) long and oval distally, located on basal part of embolus (VM 2010; Fig. 149); (3) small, with notch on median part (VM 2010; Fig. 79); (4) small, projected further than total length of embolus (VM 2010; Fig. 156)
39. Embolus, shape: (0) almost square-shaped distally (Fig. 16); (1) long, with "J"-shape (VM 2010, Fig. 199); (2) long, with upside down "S"-shape (VM 2010; Fig. 114); (3) rounded apically (VM 2010; Fig. 17); (4) triangular-shaped apically (Fig. 6); (5) triangular-shaped dorsally and rounded-shaped ventrally (VM 2010; Fig. 58); (6) conical and oval distally; (7) curved distally; (8) sigmoidal
40. Embolus, with triangular-shaped apically, position: (0) pointing in diagonal position to the longitudinal axis of femur (Fig. 8), (1) pointing in perpendicular position to the longitudinal axis of femur (Fig. 6)
41. Embolus, triangular-shaped apically, with apical ventral concavity (right arrow, Fig. 8): (0) absent, (1) present
42. Embolus, apical ventral concavity, shape: (0) small (right arrow, Fig. 8), (1) curved and long (VM 2010; Fig. 86), (2) circular and large (VM 2010; Fig. 107)
43. Bulb, embolic sclerites on retrolateral part (left arrow, Fig. 8): (0) absent, (1) present
44. Bulb, embolic sclerites on retrolateral part, shape: (0) small and triangular (left arrow, Fig. 8); (1) long and wide (VM 2010; Fig. 17); (2) long and thin (VM 2010; Fig. 58); (3) small and oval (VM 2010; Fig. 86); (4) long and triangular (VM 2010; Fig. 121); (5) small, wide and curved (VM 2010; Fig. 93); (6) long and curved (VM 2010; Fig. 164)
45. Bulb, notch between embolic sclerites and embolus (middle arrow Fig. 6): (0) absent, (1) present
46. Procursus, shape: (0) square (wider than long), (1) conical (wider basally than distally) (Figs. 6, 8, 15, 16), (2) curved (*Trichocyclus*)
47. Male palp, ventral apophysis distally on femur (VM 2010, Fig. 163): (0) absent, (1) present
48. Procursus, long rounded protuberance, ventrally (*Trichocyclus*): (0) absent, (1) present
49. Procursus, dorsal deep concavity (*Trichocyclus*): (0) absent, (1) present
50. Procursus, dorsal projection in middle part (*Priscula*): (0) absent, (1) present
51. Embolus, dorsal projection: (0) absent, (1) present
52. Embolus, dorsal projection, shape: (0) present, curved; (1) present, circular, clearly visible (VM 2010; Fig. 135)
53. Embolus, distal spine (VM 2010; Figs. 149, 206): (0) absent, (1) present
54. Embolus, retrolateral part: (0) white, poorly chitinized (Figs. 15, 16); (1) black, strongly chitinized (Figs. 6, 8)

TAXONOMY

Pholcidae C.L. Koch 1850

Physocyclus Simon 1893

Physocyclus Simon 1893:1(2), 257–488.

Type species.—*Pholcus globosus* Taczanowski 1874:105 (description ♀).

Diagnosis.—Distinguished from other pholcid genera by the combination of the following characters: epigynum with paired ventral apophysis on anterior part (Figs. 2, 3, 11, 20), epigynum with lateral constraints in middle part (arrows, Figs. 2, 20), epigynum with internal sclerotized arc with a sclerotized projection on anterior part (arrows, Figs. 4, 17), male chelicerae with lateral apophysis (Figs. 5, 9, 10, 12, 13), male palp with enlarged femur (Figs. 6, 8, 15, 16), male chelicerae with sclerotized cones frontally (> 30 cones in the *dugesi* group) (Figs. 5, 9). However, cones in the *globosus* group only present on *P. globosus* and *P. guanacaste* (0–20 cones) (Fig. 13).

Description.—Medium-sized spiders (total length 3–7 mm). Carapace usually light yellow, light brown, or with orange undertones, most species with marginal dorsal spots. Fovea with irregular pattern around it, gray or brown. Fovea forming a "Y" with posterior part of ocular region. Eight eyes on ocular region slightly high. Clypeus broad, gently sloping, in some species with two brown, gray or orange lines. Male chelicerae with lateral apophysis (except *P. mysticus* and *P. marialuisae*), apophysis variable in shape and size (Figs. 5, 9, 10, 12, 13, 18). Female chelicerae simple, without apophysis. Male chelicerae with lateral stridulatory files (Fig. 7); females of some species have lateral stridulatory files, but always smaller than the male. Male chelicerae with sclerotized cones on most of the species, variable in number and position (Figs. 5, 9). Male palp femur wide (Figs. 6, 8, 15, 16). Procursus long, dark, sclerotized, with brush of pseudotrichia (right arrow, Fig 15) and spine distally (Figs. 6, 8). Embolic sclerites with different shape and position (arrows, Figs. 8, 15; Valdez-Mondragón 2010, Figs. 10, 51, 72, 93). Embolus in retrolateral part of bulb, sclerotized, with variable shape (Figs. 6–8, 15, 16, 19), sperm duct opening distal-dorsally. Female palp simple. Sternum and labium wider than long, some species have sternum with gray, brown or dark orange spots. Endites long. Males with legs longer than females, femora with rings sub-distally, tibiae with basal and sub-distal rings, more visible in some species than others. Color on legs variable, pale or dark yellow, pale or dark orange, basal part of femora paler than the other segments, metatarsi and tarsi darker than the other segments. Legs without spines. Male legs with curved setae on tibiae and metatarsi. Opisthosoma globular (Fig. 14), thicker than long, larger in females than in males, with lateral and dorsal irregular spots, brown, white or gray. Epigynum with paired anterior ventral apophysis, with variable size and shape (Figs. 2, 3, 11, 20; Valdez-Mondragón 2010, Figs. 5, 33–38). Epigynum wider than long in most species, bell-shaped (Figs. 2, 20; Valdez-Mondragón 2010, Figs. 26, 67, 137). Epigynum with pore plates variable in

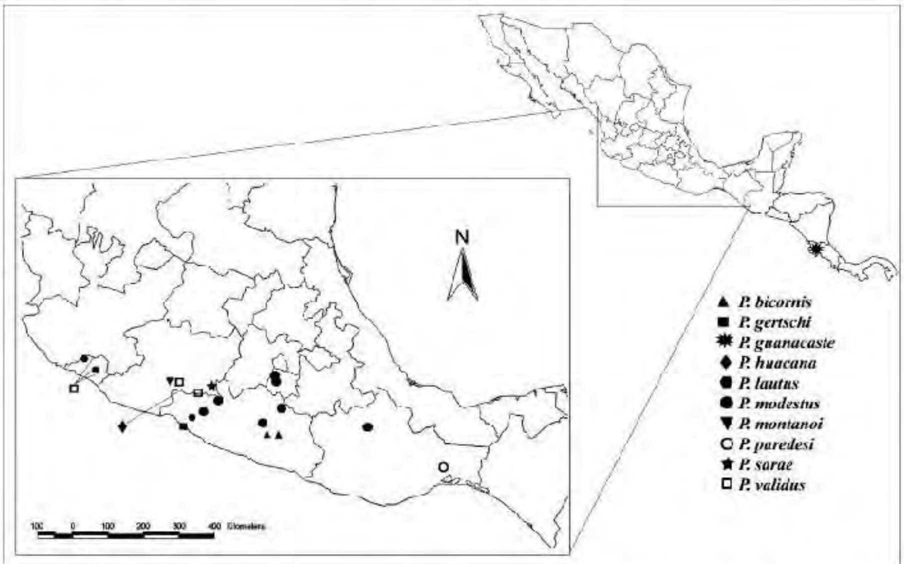


Figure 22.—Natural distribution of the species of the *globosus* group. *Physocyclus globosus* is not plotted because it is introduced in several places around the world.

size, position and shape depending on the species (Figs. 4, 17, 21; Valdez-Mondragón 2010, Figs. 27, 117, 159).

Monophyly.—The genus *Physocyclus* is defined by the following synapomorphies: 1) epigynum with paired ventral apophysis on anterior part (Figs. 2, 3, 11, 20), 2) epigynum with lateral constraints in middle part (arrows, Figs. 2, 20), and 3) epigynum with internal sclerotized arc with a sclerotized projection on anterior part (arrows; Figs. 4, 17).

Composition.—The genus *Physocyclus* is composed of 30 species in two species groups (*globosus* and *dugesi*). The *globosus* group (11 species): *P. globosus* (Taczanowski 1874), *P. bicornis* Gertsch 1971, *P. lautus* Gertsch 1971, *P. modestus* Gertsch 1971, *P. validus* Gertsch 1971, *P. guanacaste* Huber 1988, *P. gertschi* Valdez-Mondragón 2010, *P. huacana* Valdez-Mondragón 2010, *P. montanoi* Valdez-Mondragón 2010, *P. paredesi* Valdez-Mondragón 2010 and *P. sarae* Valdez-Mondragón 2010. The *dugesi* group (19 species): *P. dugesi* Simon 1893, *P. mexicanus* Banks 1898, *P. cornutus* Banks 1898, *P. tanneri* Chamberlin 1921, *P. mysticus* Chamberlin 1924, *P. enaulus* Crosby 1926, *P. californicus* Chamberlin & Gertsch 1929, *P. hoogstraali* Gertsch & Davis 1942, *P. merus* Gertsch 1971, *P. pedregosus* Gertsch 1971, *P. reddelli* Gertsch 1971, *P. brevicornus* Valdez-Mondragón 2010, *P. darwini* Valdez-Mondragón 2010, *P. franckei* Valdez-Mondragón 2010, *P. marialuisae* Valdez-Mondragón 2010, *P. michoacanus* Valdez-Mondragón 2010, *P. platnicki* Valdez-Mondragón 2010, *P. rothi* Valdez-Mondragón 2010 and *P. sprousei* Valdez-Mondragón 2010. Although *P. mexicanus* was not part of the analysis, it was included in *dugesi* group because the female holotype has a long ventral apophysis on the female epigynum as do the other species of the group.

Natural history.—Species such as *P. globosus*, *P. dugesi* and *P. enaulus* have been collected in houses and buildings (Rodríguez-Márquez & Peretti 2010, Valdez-Mondragón 2010); human activity is responsible for the wide geographic distribution of these species. Synanthropic species occupy corners of ceilings of rooms, basements, bathrooms, under sinks, under tables and benches, under stored items and furniture, and under drains for drainage of roads, in dark warm places without wind currents and with little disturbance. Some species (*P. franckei*, *P. dugesi*, *P. enaulus*, *P. hoogstraali*, *P. merus*, *P. pedregosus*, *P. tanneri*, and *P. reddelli*) inhabit dry semiarid climates, while others (*P. huacana*, *P. modestus*, *P. validus*, *P. paredesi*, *P. bicornis*, *P. californicus*, *P. cornutus*, *P. michoacanus*, *P. brevicornus*, and *P. dugesi*) prefer tropical deciduous forest, between 0–1900 m elevation. Above 1900 m elevation, they have been collected only in buildings. Scientists have never collected the genus in temperate climatic zones such as pine, oak or pine-oak forest, which are the natural habitat for other genera such as *Ixchela* Huber 2000 (Valdez-Mondragón 2013). In karst zones, it is common to find them because of their troglophilic habits; some species have been collected in the entrances of caves and inside on crevices in walls and on formations (stalactites, stalagmites and columns). This is the case for *P. bicornis*, *P. dugesi*, *P. enaulus*, *P. franckei*, *P. hoogstraali*, *P. lautus*, *P. merus*, *P. modestus*, *P. pedregosus*, *P. reddelli*, *P. tanneri*, and *P. validus*. Outside the caves, their natural habitat is in rock walls, between rocks and dark crevices, with high humidity, warm temperature, and protection from strong wind drafts. Bridges and culverts under roads and railroad tracks are excellent collecting spots.

Distribution.—*Physocyclus* has a natural distribution in North America, with most of the species known found in Mexico (Figs. 22, 23), with *P. californicus*, *P. enaulus*, *P. hoogstraali*, and *P. tanneri* distributed in the southern part of the United States, and *P. guanacaste* distributed in Costa Rica. *P. dugesi* has been introduced into Costa Rica and Venezuela, although this last record of Caporiacco (1955) could be

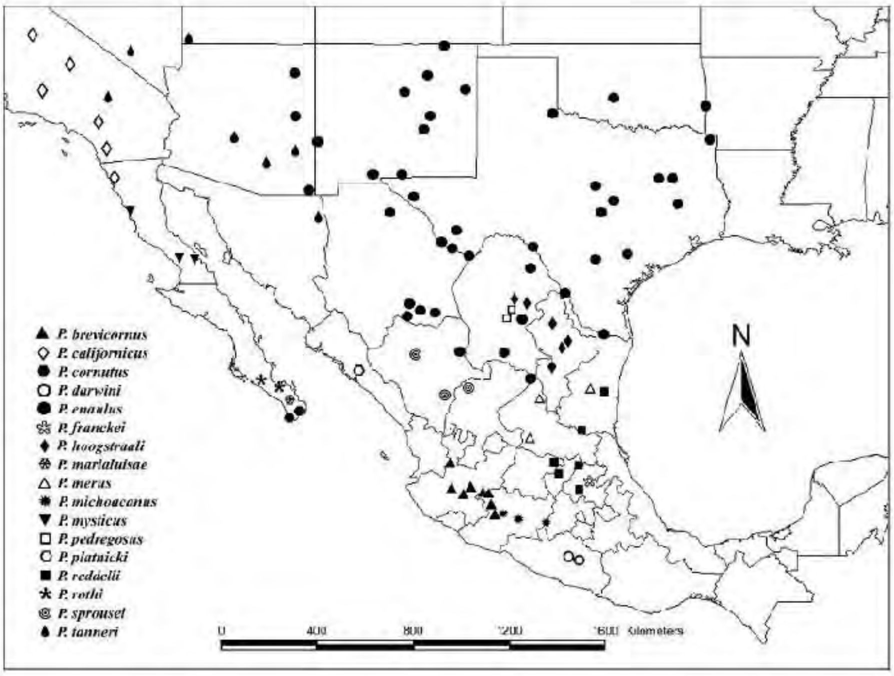


Figure 23.—Natural distribution of the species of the *dugesi* group. *Physocyclus dugesi* is not present because it is an introduced species in Central and South America.

erroneous (B. Huber pers. comm.). *P. globosus* has been introduced and reported in different countries around the world (Valdez-Mondragón 2010).

DISCUSSION

The subfamily Arteminae proposed by Huber (2011) is composed of the genera *Holocneminus*, *Artema*, *Tibetia*, *Physocyclus* and *Trichocyclus*; and previous studies have always supported the subfamily (Huber 2001; Bruvo-Madarić et al. 2005). The paired dorsal apophysis and the ventral notch basally on the procursus of the male palp (char. 29) (Huber 2000, 2001) define this subfamily. Recently, Dimitrov et al. (2013), using molecular data, also transferred the genera *Nita* and *Wugigarra* (previously in Modisiminae) to Arteminae. *Wugigarra* also has a paired dorsal apophysis and a basal ventral notch on the procursus of the male palp (B. Huber pers. comm.; A. Valdez-Mondragón pers. obs.), as the do rest of the genera of the subfamily.

In this analysis, I found a trichotomy among *Artema*, *Trichocyclus*, and *Physocyclus* (Fig. 1); Dimitrov et al. (2013) considered *Physocyclus* and *Trichocyclus* to be sister taxa based on the reduction of the epiandrous spigots and preliminary molecular evidence (Huber 2001; Bruvo-Madarić et al. 2005).

The monophyly of the genus *Physocyclus* is supported by three synapomorphies, with high Jackknife and Bremer values that support the genus at 72% and 2 respectively (Fig. 1). The first synapomorphy is the paired ventral apophysis on the anterior part of the epigynum (char. 7) (Figs. 2, 3, 11, 20). However, the apophyses of the species differ in shape, and each species has a particular diagnostic shape. There were two apophysis patterns: conical and short in the *globosus* group (Figs. 11, 20) and long, curved and wide in most of the species in the *dugesi* group (Figs. 2, 3), but these apophyses are absent on *P. validus*, likely a secondary loss (Valdez-Mondragón 2010, Fig. 116). The second character is the lateral constraints in the middle part of the epigynum (char. 8) (arrows, Figs. 2, 20). This character is inconspicuous or barely visible on the species of the *globosus* group (char. 9, character state 0) (Fig. 20), whereas in the *dugesi* group, the shape is very marked (char. 9, character state 1) (Fig. 2). The third character is the arc of the uterus with a single sclerotized projection on its anterior part (char. 12, character state 1) (arrows, Figs. 4, 17), although it is hard to tell if this simple sclerotized projection belongs only to *Physocyclus* or may be present in other genera of Arteminae. At least in *Artema*, this character is present but with two sclerotized projections (char. 12, character state 2), whereas in *Priscula*, *Trichocyclus*, and *Wugigarra* (Huber 2001, Figs. 9, 27, 42), this sclerotized projection is absent. Although the analysis found that a fourth character supporting the monophyly of *Physocyclus* is the curved setae on the tibiae and metatarsi of the legs (char. 15), this character has evolved several times convergently within the subfamilies Arteminae, Modisiminae and Smeringopinae (Huber 2000, 2011). This character was unknown in *P. guanacaste*, *P. lautus*, and *P. gertschi* due to bad specimen preservation and missing legs, and even these curved setae are absent in *P. paredesi* and *P. bicornis*.

Globosus group: The phylogenetic relationships among the species of this group were the same in the 12 most parsimonious trees found in the analysis (Fig. 1). The monophyly of the group is supported by five synapomorphies.

Characters 3 and 4 are a functional unit because these structures are in contact when the female moves its opisthosoma toward the prosoma. However, these characters were coded as different because they were treated as just one character. The analysis found 24 most parsimonious trees, collapsing nine clades with lower values of Ci and Ri. Although the shape of the pore plates is variable in the different species of both groups (char. 10), all species of the *globosus* group share the oval shape (Figs. 17, 21). The dorso-distal spine on the embolus (char. 30) is absent on *P. validus* and can be considered a reversal. In the other species, this spine has different sizes and shapes, which make codification difficult. The dorsal embolic sclerites on the embolus (char. 37) (left arrow, Fig. 15) in the *globosus* group are present on all species. However, the shape of the embolic sclerites (char. 38), which was coded as a multistate character, varies. Only the character state (0): large and wide, almost the total length of the embolus, is shared [*P. lautus* (*P. bicornis* + *P. gertschi*)] (Figs. 1, 16). The large distal spine on the procursus (char. 35) (Figs. 6, 8) is present in all species of the group except *P. huacana*. This character apparently appeared convergently twice, in the *globosus* group (except *P. huacana*) and in most of the species of the *dugesi* group, except *P. platnicki*, *P. cornutus* and *P. rothi* (Fig. 1).

The clade [*P. montanoi* (*P. modestus* + *P. sarae*)] is supported by the lateral apophysis of male chelicerae in a frontal-retrolateral position (char. 17, character state 2) and male chelicerae with discontinuous files on the wide, shield-shaped apophysis (char. 21, character state 1) (arrow, Fig. 12). This clade had a low Jackknife support value (22%), but a high Bremer support value of 4 (Fig. 1). The position of the lateral apophysis of the male chelicerae was coded as multistate because in both groups the position varies: proximal (character state 0), on the middle part (1), lateral (3) or distally (4). Although the discontinuous files on the apophysis of the male chelicerae support the clade [*P. montanoi* (*P. modestus* + *P. sarae*)], the lateral stridulatory files (char. 20) apparently have evolved convergently several times in different genera of subfamilies Ninetinae, Arteminae and Smeringopinae, except in Modisiminae and Pholcinae (Huber 1995, 2000, 2011a).

Physocyclus globosus + *P. guanacaste* are sister species. Although the shape of the lateral apophysis of the male chelicerae (char. 18) is a multistate character with nine character states, in both species it is small and irregular (character state 9) (Fig. 13). Besides, *P. globosus* + *P. guanacaste* was the only close relationship in the group with high Jackknife and Bremer support values of 84% and 2, respectively (Fig. 1). Another synapomorphy that supports *P. globosus* + *P. guanacaste* is the male chelicerae with a pale basal half and a brown distal half (char. 25) (Fig. 13).

Coding of the apophysis shape of the male chelicerae was difficult due to the variation in the two groups; some of the character states were even autapomorphies for certain species, such as *P. platnicki* and *P. lautus*. This character is also absent in *P. mysticus* and *P. marialuisae* and is considered a reversal. Similarly challenging was the coding of the position of the lateral apophysis of the male chelicerae (char. 17), it being a multistate and homoplastic character (Fig. 1). The bag-shaped structures below each pore plate (char. 11) (arrow, Fig. 21) were found in some species of this group. These structures have apparently evolved convergently twice in the clade *P. modestus* + *P. sarae*, and in the clade composed from *P. validus* to *P. gertschi* (Fig. 1). This character is a reversion in *P. bicornis*.

Although the dorsal embolic sclerites consisted of several shapes (char. 38), they were large and wide for almost the total length of the embolus (character state 0) (Fig. 16), supporting the clade [*P. lautus* (*P. bicornis* + *P. gertschi*)]. In some cases, the character states are diagnostic for such species as *P. modestus*, *P. huacana* and *P. montanoi* (Valdez-Mondragón 2010: Figs. 79, 150, 156). Finally, the conical frontal-distal apophysis on the male chelicerae (char. 27) (arrow, Fig. 18; Valdez-Mondragón 2010, Figs. 197, 204) is a character that may have appeared convergently twice in both species groups because it is present in *P. paredesi* and *P. lautus* (*globosus* group) and *P. platnicki* (*dugesi* group).

Dugesi group: In comparison with the *globosus* group, there were changes in the relationships among the species of the *dugesi* group in the 12 most parsimonious trees, with the strict consensus showing the internal relationships in the group (Fig. 1). The monophyly of the group is supported by four synapomorphies. Although the shape of the lateral male chelicerae (char. 18) (Fig. 5, 9, 10) seems to support the group, this character has several character states, one being that the lateral apophysis is small and conical (character state 0) (Fig. 5), the shape that is shared among most of the species (*P. californicus*, *P. enaulus*, *P. merus*, *P. brevicornus*, *P. sprousei*, *P. dugesi*, *P. darwini* and *P. tanneri*). The small, conical lateral apophysis is a plesiomorphic or ancestral state, whereas conical and long (character state 1) (Figs. 9, 10) is a derived state, shared with *P. reddelli*, *P. michoacanus*, *P. hoogstraali*, and *P. pedregosus*, but absent on *P. mysticus* and *P. marialuisae* (Valdez-Mondragón 2010; Figs. 84, 161). The embolus shape (char. 39) seems to support the group. However, four different character states were coded, one being an apically triangular embolus (character state 4) (Fig. 6), the state shared in the most of the species except *P. platnicki*, *P. cornutus*, *P. rothi*, *P. hoogstraali*, and *P. pedregosus*. Another character that supports the group is the strongly visible, sclerotized retrolateral region around the male bulb (char. 34, character state 1) (arrow, Fig. 7), absent in *P. platnicki*. About the shape of embolic sclerites on the retrolateral part of bulb (char. 44), apparently the plesiomorphic state was characterized by the species that share long and wide embolic sclerites (character state 1) (Valdez-Mondragón, Figs. 17, 185), whereas the derived state in most of the species was defined by small, triangular embolic sclerites (character state 0) (Figs. 6, 7; left arrow Fig. 8).

Four synapomorphies support the largest clade within the group from *P. californicus* to *P. pedregosus* (Fig. 1); however, this clade is weakly supported with a low Jackknife value of 17%, although supported by with Bremer values of 2. The first synapomorphy is the pale concavity on each chelicera of the male (char. 26) (arrow, Fig. 5) (absent on *P. marialuisae*). The second synapomorphy is the apical position of the triangular-shaped embolus (char. 40); although this is a multistate character, most of the species have a triangular embolus pointing in a perpendicular position to the longitudinal axis of the femur (character state 1) (Fig. 6). Although there is a polytomy within the relationships of this clade (Fig. 1), this character state might be plesiomorphic, because *P. enaulus, P. merus, P. sprousei,* and *P. mysticus* have the triangular embolus pointing diagonally to the longitudinal axis of the femur (character state 0) (Fig. 8), which could be considered a derived state. This is the same for *P. hoogtraali* + *P. pedregosus* that have an embolus that is triangular dorsally and rounded ventrally (derived state) (char. 39, character state 5) (Valdez-Mondragón 2010; Figs. 58, 93). In species with an apical triangular embolus, the apical ventral concavity on the embolus (char. 41) (right arrow, Fig. 8) in *P. enaulus, P. merus, P. sprousei, P. tanneri, P. mysticus, P. marialuisae* and *P. michoacanus* seems to have evolved several times convergently (Fig. 1). The third synapomorphy that seems to support the clade is character 51, the curved dorsal projection on the embolus (Valdez-Mondragón 2010; Fig. 10); however, this character has been lost several times (*P. enaulus, P. merus, P. sprousei,* and *P. hoogtraali* + *P. pedregosus*) (Fig. 8). The fourth synapomorphy is the position of the sclerotized cones of the male chelicerae (char. 24), although most of the species have cones on the basal half and the prolateral part of the chelicerae and lateral apophysis (character state 0) (Valdez-Mondragón 2010; Fig. 29, 70, 105). The plesiomorphic state or ancestral state seems to have cones on the basal half and on the prolateral part of the chelicerae and lateral apophysis, leaving a basal zone on the prolateral part without cones (character state 1), which is present on *P. cornutus* and *P. rothi* (Valdez-Mondragón 2010; Figs. 15, 183). The derived character state consists of cones on the prolateral part and toward the prolateral part of the lateral apophysis, leaving an area of half-moon shape without cones between them (character state 3) on *P. mysticus* and *P. reddelli* (Fig. 9); and cones scattered throughout the chelicerae (character state 4) appearing twice convergently on *P. franckei* and *P. marialuisae* (Valdez-Mondragón 2010; Figs. 119, 161).

Finally, the only clade supported with high Jackknife and Bremer values is *P. pedregosus* and *P. hoogstraali*, with 76% and 3 respectively. The characters that support this close relationship include the epigynum with lateral median protuberances (char. 14) (Valdez-Mondragón 2010; Figs. 60, 95) and the dorsally triangular and ventrally rounded embolus (char. 39, character state 5) (Valdez-Mondragón 2010; Figs. 58, 93).

Biogeography.—Analyzing the distribution of the two species groups, I note that the *globosus* group has a distribution in the Mesoamerican and Mexican Mountain biotic components, following the biogeographical scheme of Mexico (Morrone 2004, 2005) (Fig. 22), whereas the *dugesi* group is distributed in the Mesoamerican and Continental Nearctic components (Fig. 23). The biotic components are defined by taxa with a common history, which form biogeographical patterns (Morrone 2005). The biogeography of Mexico is extremely complex; there were several dispersal and vicariance events because Nearctic and the Neotropical biotic elements, known as the Mexican Transition Zone, overlap in Mexico, (Morrone 2005; Brooks 2005). Halffter et al. (1995). Halffter (2003) reviewed this condition, working with the insects of the region.

The Mexican Transition Zone is geographically delimited by the Transmexican Volcanic Belt, a mountain complex in central Mexico (states of Guanajuato, Estado de México, Distrito Federal, Jalisco, Michoacán, Puebla, Oaxaca, Tlaxcala, and Veracruz) (Morrone 2006). By analyzing the distribution of the *globosus* and *dugesi* species groups, I determined that the *globosus* group has a natural distribution primarily toward the south of the Transmexican Volcanic Belt (Neotropical region) (Fig. 22), while the *dugesi* group has a natural distribution toward the north of the Transmexican Volcanic Belt (Nearctic region) (Fig. 23). Given the complex biogeography in Mexico, apparently a large-scale vicariant event separated the two major clades within the genus *Physocyclus* (Fig. 1).

In conclusion, although the genus *Physocyclus* is monophyletic, as are the two species groups within, numerous internal polytomies, mostly within the *dugesi* group, blur a clear phylogenetic picture at the species level. Future studies should use new evidence and add molecular data to help resolve the relationships among the species.

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Appendix.—Character matrix used in the phylogenetic analyses, composed of 33 taxa (29 ingroup, 4 outgroup), and 54 morphological characters (44 binary and 10 multistate).

Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Priscula binghamae	1	1	0	0	0	0	0	0	-	0	0	0	0	0	0	0	-	-	0	0	0	0	-	-	0	0	0	1	0	0	0	0	0	0	0	1	0	-	8	-	-	-	0	-	-	1	1	0	0	1	0	-	0	0
Artema atlanta	1	0	0	0	0	0	0	0	-	3	0	2	0	0	0	1	3	3	0	0	0	0	-	-	0	0	0	0	1	0	0	0	0	0	0	1	0	-	7	-	-	-	0	-	0	0	0	0	0	0	0	-	0	1
Trichocyclus nigropunctatus	0	1	0	0	0	0	0	0	-	5	0	0	0	0	0	0	-	-	1	1	0	0	-	-	0	0	0	0	1	0	0	0	0	0	0	0	0	-	6	-	-	-	0	-	0	2	0	1	1	0	0	-	0	0
Trichocyclus nullarbor	0	1	0	0	0	0	0	0	-	5	0	0	0	0	0	0	-	-	1	1	0	0	-	-	0	0	0	0	1	0	0	0	0	0	0	0	0	-	6	-	-	-	0	-	0	2	0	1	1	0	0	-	0	0
P. huacana	1	1	1	1	0	1	1	1	0	2	0	1	0	0	1	1	1	2	0	1	0	0	-	-	0	0	0	0	1	1	0	1	0	0	0	1	1	2	0	-	-	-	0	-	0	1	0	0	0	0	0	-	1	0
P. montanoi	1	1	1	1	0	0	1	1	0	2	0	1	0	0	1	1	2	2	0	1	1	0	-	-	0	0	0	0	1	1	0	0	0	0	1	1	1	4	0	-	-	-	0	-	0	1	0	0	0	0	0	-	0	0
P. modestus	1	1	0	0	0	0	1	1	0	2	1	1	0	0	1	1	2	2	0	1	1	0	-	-	0	0	0	0	1	1	0	0	0	0	1	1	1	3	0	-	-	-	0	-	0	1	0	0	0	0	0	-	0	0
P. sarae	1	1	0	0	0	0	1	1	0	2	1	1	1	0	1	1	2	2	0	1	1	0	-	-	0	0	0	0	1	1	0	0	0	0	1	1	1	1	0	-	-	-	0	-	0	1	0	0	0	0	0	-	0	0
P. globosus	1	1	1	1	0	0	1	1	0	2	0	1	1	0	1	1	1	9	0	1	0	1	0	-	1	0	0	0	1	1	0	0	0	0	1	1	1	1	0	-	-	-	0	-	0	1	0	0	0	0	0	-	0	0
P. guanacaste	1	1	1	1	0	0	1	1	0	2	0	1	1	0	?	1	1	9	0	1	0	1	0	-	1	0	0	0	1	1	0	0	0	0	1	1	1	1	0	-	-	-	0	-	0	1	0	0	0	0	0	-	0	0
P. validus	1	1	1	1	0	0	0	1	0	2	1	1	1	0	1	1	1	6	0	1	0	0	-	-	0	0	0	0	1	0	0	0	0	0	1	1	1	1	2	-	-	-	0	-	0	1	0	0	0	0	0	-	0	0
P. paredesi	1	1	1	1	0	0	1	1	0	2	1	1	1	0	0	1	0	7	0	1	0	0	-	-	0	0	1	0	1	1	0	0	0	0	1	1	1	1	0	-	-	-	0	-	0	1	0	0	0	0	0	-	1	0
P. lautus	1	1	1	1	0	1	1	1	0	2	1	1	1	0	?	1	0	5	0	1	0	0	-	-	0	0	1	0	1	1	0	0	0	0	1	1	1	0	0	-	-	-	0	-	0	1	0	0	0	0	0	-	0	0
P. bicornis	1	1	0	0	0	1	1	1	0	2	0	1	1	0	0	1	1	6	0	1	0	0	-	-	0	0	0	0	1	1	0	0	0	0	1	1	1	0	0	-	-	-	0	-	0	1	0	0	0	0	0	-	0	0
P. gertschi	1	1	0	0	0	1	1	1	0	2	1	1	0	0	?	1	0	7	0	1	0	0	-	-	0	0	0	0	1	1	0	0	0	0	1	1	1	0	0	-	-	-	0	-	0	1	0	0	0	0	0	-	0	0
P. platnicki	1	1	0	0	0	1	1	1	1	1	0	1	0	0	1	1	4	8	0	1	0	1	0	-	0	0	1	0	1	0	0	0	0	0	0	1	0	-	1	-	-	-	1	1	1	1	0	0	0	0	0	-	0	1
P. cornutus	1	1	0	0	0	0	1	1	1	1	0	1	0	0	1	1	1	1	0	1	0	1	1	1	0	0	0	0	1	0	0	0	0	1	0	1	0	-	3	-	-	-	1	1	1	1	0	0	0	0	0	-	0	1
P. rothi	1	1	0	0	0	0	1	1	1	1	0	1	0	0	1	1	0	4	0	1	0	1	1	1	0	0	0	0	1	0	0	0	0	1	0	1	0	-	3	-	-	-	1	1	1	1	0	0	0	0	0	-	0	1
P. franckei	1	1	0	0	0	0	1	1	1	4	0	1	0	0	1	1	0	4	0	1	0	1	1	4	0	0	0	0	1	0	1	0	0	1	1	1	0	-	4	0	0	-	1	4	0	1	0	0	0	0	0	-	0	1
P. californicus	1	1	0	0	0	0	1	1	1	1	0	1	0	0	1	1	1	0	0	1	0	1	1	0	0	1	0	0	1	0	0	0	0	1	1	1	0	-	4	1	0	-	1	0	1	1	0	0	0	0	1	1	0	1
P. enaulus	1	1	0	0	0	0	1	1	1	0	0	1	0	0	1	1	1	0	0	1	0	1	1	0	0	1	0	0	1	0	0	0	0	1	1	1	0	-	4	0	1	0	1	0	1	1	0	0	0	0	0	-	0	1
P. merus	1	1	0	0	0	0	1	1	1	0	0	1	0	0	1	1	1	0	0	1	0	1	1	0	0	1	0	0	1	0	0	0	0	1	1	1	0	-	4	0	1	0	1	0	1	1	0	0	0	0	0	-	0	1
P. tanneri	1	1	0	0	0	0	1	1	1	0	0	1	0	0	1	1	1	0	0	1	0	1	1	0	0	1	0	0	1	0	0	0	0	1	1	1	0	-	4	1	1	2	1	0	1	1	0	0	0	0	1	0	0	1
P. brevicornus	1	1	0	0	0	0	1	1	1	1	0	1	0	0	1	1	1	0	0	1	0	1	1	0	0	1	0	0	1	0	0	0	0	1	1	1	0	-	4	1	0	-	1	0	1	1	0	0	0	0	1	1	0	1
P. sprousei	1	1	0	0	0	0	1	1	1	0	0	1	0	0	1	1	1	0	0	1	0	1	1	0	0	1	0	0	1	0	0	0	0	1	1	1	0	-	4	0	1	0	1	0	1	1	0	0	0	0	0	-	0	1
P. dugesi	1	1	0	0	0	0	1	1	1	0	0	1	0	0	1	1	1	0	0	1	0	1	1	2	0	1	0	0	1	0	0	0	0	1	1	1	0	-	4	1	0	-	1	0	1	1	0	0	0	0	1	0	0	1
P. darwini	1	1	0	0	0	0	1	1	1	0	0	1	0	0	1	1	1	0	0	1	0	1	1	2	0	1	0	0	1	0	0	0	0	1	1	1	0	-	4	1	0	-	1	0	1	1	0	0	0	0	1	0	0	1
P. reddelli	1	1	0	0	0	0	1	1	1	0	0	1	0	0	1	1	1	1	0	1	0	1	1	3	0	1	0	0	1	0	1	0	0	1	1	1	0	-	4	1	0	-	1	0	1	1	0	0	0	0	1	0	0	1
P. mysticus	1	1	0	0	0	0	1	1	1	0	0	1	0	0	1	0	-	-	0	1	0	1	1	3	0	1	0	0	1	0	0	0	1	1	1	1	0	-	4	0	1	1	1	3	1	1	0	0	0	0	1	0	0	1
P. marialuisae	1	1	0	0	1	0	1	1	1	0	0	1	0	0	1	0	-	-	0	1	0	1	1	4	0	0	0	0	1	0	0	0	0	1	1	1	0	-	4	1	1	1	1	6	1	1	1	0	0	0	1	0	0	1
P. michoacanus	1	1	0	0	0	0	1	1	1	0	0	1	0	0	1	1	1	1	0	1	0	1	1	0	0	1	0	0	1	0	0	0	0	1	1	1	0	-	4	1	1	1	1	2	1	1	0	0	0	0	1	0	0	1
P. hoogstraali	1	1	0	0	0	0	1	1	1	0	0	1	0	1	1	1	1	1	0	1	0	1	1	0	0	1	0	0	1	0	0	0	0	1	1	1	0	-	5	-	-	-	1	2	1	1	0	0	0	0	0	-	0	1
P. pedregosus	1	1	0	0	0	0	1	1	1	0	0	1	0	1	1	1	1	1	0	1	0	1	1	0	0	1	0	0	1	0	0	0	0	1	1	1	0	-	5	-	-	-	1	5	1	1	0	0	0	0	0	-	0	1