

Distribution and observations on the biology of *Telchin atymnius futilis* (Walker, 1856) (Castniidae: Castniinae) in Mexico

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Abstract: *Telchin atymnius futilis* (Walker, 1856) is one of the few Castniidae with distribution in Mexico that is not endemic to the country. Starting from greater knowledge of its geographical distribution and field studies carried out in recent years, bionomic details as well as previously unknown information on its ecology, plant associations and behavioral aspects are provided. Likewise, the taxon's variability and geographical distribution in Mexico is analyzed.

Key words: biogeography, bionomics, distribution, Lepidoptera, Mexico, variability.

Resumen: *Telchin atymnius futilis* (Walker, 1856) es uno de los pocos Castniidae con distribución en México que no es endémico para el país. Teniendo ahora mayores conocimientos sobre su distribución geográfica y gracias a estudios de campo realizados en los últimos años, se proporcionan detalles bionómicos, así como sobre su ecología, asociaciones con plantas y aspectos de comportamiento previamente desconocidos. De igual forma se analiza la variabilidad del taxón y su distribución geográfica en México.

Palabras clave: aspectos bionómicos, biogeografía, distribución, Lepidoptera, México, variabilidad.

INTRODUCTION

In the Americas, the family Castniidae is distributed from Mexico to Argentina, including the Caribbean (Miller, 1986; González & Cock, 2004; López-Godínez & Porion, 2012; García-Díaz *et al.*, 2020). In general, the family is poorly represented in entomological collections worldwide (Vinciguerra *et al.*, 2011; Moraes & Duarte, 2014; Worthy *et al.*, 2017; González & Domagała, 2019). Nevertheless, interest in Castniidae by Mexican collectors and researchers has increased considerably in the past two decades (García-Díaz *et al.*, 2019); as a result, we now have better representation in Mexican collections, both institutional and private. In Mexico, most taxa that are distributed in rainforests, semideciduous forests and cloud forests on the Gulf of Mexico slope are not endemic to the country. Among them is *Telchin atymnius futilis* (Walker, 1856), a taxon that is considered the most 'common' in Mexico.

Castnia atymnius Dalman, 1824, was described based on material from Brazil, while *Castnia futilis* Walker, 1856, and *Castnia salasia* Boisduval, [1875] were described from material from Nicaragua and Mexico, respectively; however, the last name is considered to be a synonym of *C. futilis*. Houlbert (1918) considered *Castnia atymnius* in the genus *Castniomera* Houlbert, 1918, without mentioning *Castnia futilis*. Both taxa were considered two different species until Miller (1986), based on morphological similarities between them, determined that *Castniomera atymnius* is a valid species and that *Castniomera futilis* is not; however, she placed *futilis* as a subspecies of *atymnius*. This subspecific position was maintained in Miller

(1995), Lamas (1995) and subsequent publications to this date. For their part, Moraes & Duarte (2009) synonymized *Castniomera* with *Telchin*, Hübner, 1825.

Currently, *T. atymnius* includes seven recognized subspecies throughout the continent (*atymnius*, *drucei* (Schaus, 1911), *ecuadorensis* (Houlbert, 1917), *futilis*, *humboldti* (Boisduval, [1875]), *immaculata* (Lathy, 1922), *newmanni* (Houlbert, 1917)), distributed from Mexico to Brazil, with *T. a. futilis* being the one with the northernmost distribution (Mesoamerica). *Telchin atymnius* is a species often associated with heliconias (*Heliconia* spp.: Heliconiaceae) and banana trees (*Musa* spp.: Musaceae), which are its host plants (Gallego, 1946, 1963; Lara, 1964a; Miller, 1986; González & Cock, 2004; González *et al.*, 2010; González *et al.*, 2017; González & Domagała, 2019). Consequently, some subspecies are of great economic and commercial importance since they are pests of banana plantain crops. The subspecies *Telchin atymnius humboldti* is cited by Lara (1964a, 1964b, 1965, 1966a, 1966b), who described and analyzed in great detail the taxon's adult morphology, its complete life cycle and the damage it causes in banana plantations in Costa Rica.

Starting from a compilation of localities where *T. atymnius futilis* has been observed in Mexico, a map of its distribution in the country was prepared. Additionally, through the author's collecting and personal observations, and information provided by Roberto G. de la Maza, Filiberto Mora and Alejandro González, relevant bionomic aspects of this subspecies are discussed, and its different host plants in Mexico are documented.

MATERIALS AND METHODS

Telchin atymnius futilis distribution records were located while searching the following institutional and private collections: Private collection of José de Jesús García-Díaz, Tehuacán, Puebla, Mexico (JJGD); Private collection of the Haghenbeck Family, Tehuacán, Puebla, Mexico (CFH); Private collection of the De la Maza Family, Mexico City, Mexico (CDM); Private collection of Bernardo López-Godínez, Guadalajara, Mexico (BLG); Private collection of the Turrent Family, Mexico City, Mexico (CFT); Private collection of the Villarreal Family, Oaxaca, Oaxaca, Mexico (CFV); Private collection of Robert Worthy, Caterham, Surrey, U.K. (RW); Private collection of Dirk Casteleyn, Brugge, West Flanders, Belgium (DC); Private collection of Daniel J. Curoe, Mexico City, Mexico (DJCC); Colección Entomológica del Instituto de Biología de la Universidad Nacional Autónoma de México, Mexico City, Mexico (IBUNAM); Museo de Historia Natural de la Ciudad de México, Mexico City, Mexico (MHNCM); Colección Entomológica de la Facultad de Ciencias Agronómicas de la Universidad Autónoma de Chiapas, Villaflores, Chiapas, Mexico (UNACH); Yale Peabody Museum of Natural History, New Haven, USA (YPM); Museum für Naturkunde, Berlin, Germany (ex-ZMHB: Zoologisches Museum der Humboldt Universität zu Berlin, Germany) (MfNB); American Museum of Natural History, New York, USA (AMNH).

Bionomic information was obtained based on the author's personal observations in San Felipe Jalapa de Díaz, Oaxaca, and El Vigía, Veracruz; also from Roberto G. de la Maza in the ADVC (Área Destinada Voluntariamente a la Conservación) Koliijke, Puebla; Filiberto Mora (in Santiago Yancuitalpan, Puebla); and Alejandro González-Castillo (in Xilitla, San Luis Potosí).

The distribution map of *T. atymnius futilis* was prepared using SimpleMappr (Shorthouse, 2010). Georeferencing of localities was done by means of Google Earth. The photos of the specimens illustrated in Figure 4 were taken with a Fujifilm FinePix HS20EXR camera. Adobe Photoshop 2020 was used for figures editing.

RESULTS

Biogeographical comments and distribution. In Mexico, north of the Isthmus of Tehuantepec, *Telchin atymnius futilis* has a restricted distribution within rainforests, semideciduous forests and cloud forests of the central and northern slopes facing the Gulf of Mexico. South of the Isthmus of Tehuantepec, in the states of Chiapas and Oaxaca, it has been located on both the Gulf and the Pacific slopes. Its northernmost known distribution point is Xilitla, San Luis Potosí; however, its distribution possibly extends through the state to humid regions of northern Veracruz or southern Tamaulipas, although Irmin García-Morales & Jesús García-Jiménez (pers. comm.) point out that it has not been observed in the El Cielo Biosphere Reserve (RBEC), in Tamaulipas. The following is a list of localities where the taxon has been sighted and collected: **Campeche:** Calakmul; **Chiapas:** Bonampak, Cerro Cebú, Chajul, Cintalapa, El Ocote, Frontera Corozal, Huixtla, La

Granja, Laguna Bélgica, Mazatán, Ocuilapa, Palenque, San Quintín, Selva Negra, Tapachula, Yajalón; **Hidalgo:** Puerto del Caballo; **Oaxaca:** Arroyo de Banco, La Esperanza, La Soledad, La Trinidad, Metates, Rancho San Carlos, San José Chiltepec, San Felipe Jalapa de Díaz, San Pedro Tapanatepec, Santa María Chimalapa, Soyolapam, Valle Nacional; **Puebla:** ADVC Koliijke, Barranca de Patla, Cuetzalan, La Ceiba, Mazatzongo de Guerrero, Presa La Soledad, Tlaxcalantongo, Xicoteppec de Juárez, Yancuitalpan; **Querétaro:** Río Tancuilín; **San Luis Potosí:** Tamazunchale, Xilitla; **Tabasco:** Huimanguillo, Santa Rosalía, Teapa; **Veracruz:** Atoyac, Cerro El Vigía, Coatepec, Coatzacoalcos, Córdoba, Dos Amates, Fortín de las Flores, Hacienda El Mirador, Ixtaczoquitlán, Misantla, Orizaba, Presidio, Reserva Ecológico Santa Gertrudis, Tezonapa, Volcán San Martín, Volcán Santa Martha, Xico (Fig. 3). Likewise, there are records of the taxon in various localities in Central America: Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica and Panama (Miller, 1986; Miller, 1995; Lamas, 1995; González & Hernández-Baz, 2012; van den Bergh *et al.*, 2020). Druce (1883) illustrated a specimen of '*Castnia futilis*' from Costa Rica; however, it is evident that this specimen corresponds to *Telchin atymnius drucei*. It is possible that in other bibliographical sources there are confusions or erroneous references between subspecies (*e.g.*, Westwood, 1877).

Ecology and behavior. *Telchin a. futilis* coexists with different castniid species in various localities in Mexico. In the great majority of these localities, it is sympatric with *Athis inca orizabensis* (Strand, 1913), while in a few it flies together with *A. delecta* (Schaus, 1911), *A. inca inca* (Walker, 1854), *T. evalthe viryi* (Boisduval, [1875]) or *Telchin diva diva* (Butler, 1870), depending on the region. The elevations of the localities where it is distributed ranges from 0-1900 m above sea level; however, it is most frequently observed between 400-1200 m. It is recorded from mid-March to mid-November, depending on the locality, and the beginning and duration of the rainy season. There is a record of the taxon from Palenque, Chiapas (January). Its flight period is longer than that of the other castniid species with distribution in Mexico; its extensive distribution in different ecosystems favors a long flight period, unlike other species. It does not show a particular preference with respect to its flight zone, since it often flies in open sunny places such as ravines or the banks of rivers and streams, and open areas shaded by trees over 15 m high, always in proximity to one of its host plants. Roberto de la Maza (pers. comm.) points out that the host plant species at ADVC Koliijke (Puebla) are *Heliconia latispatha* Benth. (Fig. 2G), *H. bourgaeana* Petersen (Fig. 2F), *H. collinsiana* Griggs (Fig. 2E) and *H. rostrata* Ruiz & Pav. (Heliconiaceae). Moreover, Filiberto Mora (pers. comm.) indicates that *T. atymnius futilis* is associated with various host plants in Yancuitalpan, Puebla; he has observed several females ovipositing on *H. bourgaeana* (Fig. 2F) and *H. rostrata* (Heliconiaceae), *Canna tuerckheimii* Kraenzl. (Cannaceae), and on one occasion on *Etlingeria elatior* (Jack) R.M.Sm. (Zingiberaceae). Also, Lugo-Cruz *et al.* (2020) indicate that this subspecies attacks crops of *H. psittacorum* L.f., *H. bihai* (L.) L. and *H. stricta* Huber in a Cárdenas, Teapa, Tabasco, plantation. As with the other castniid species in Mexico, *T. a.*

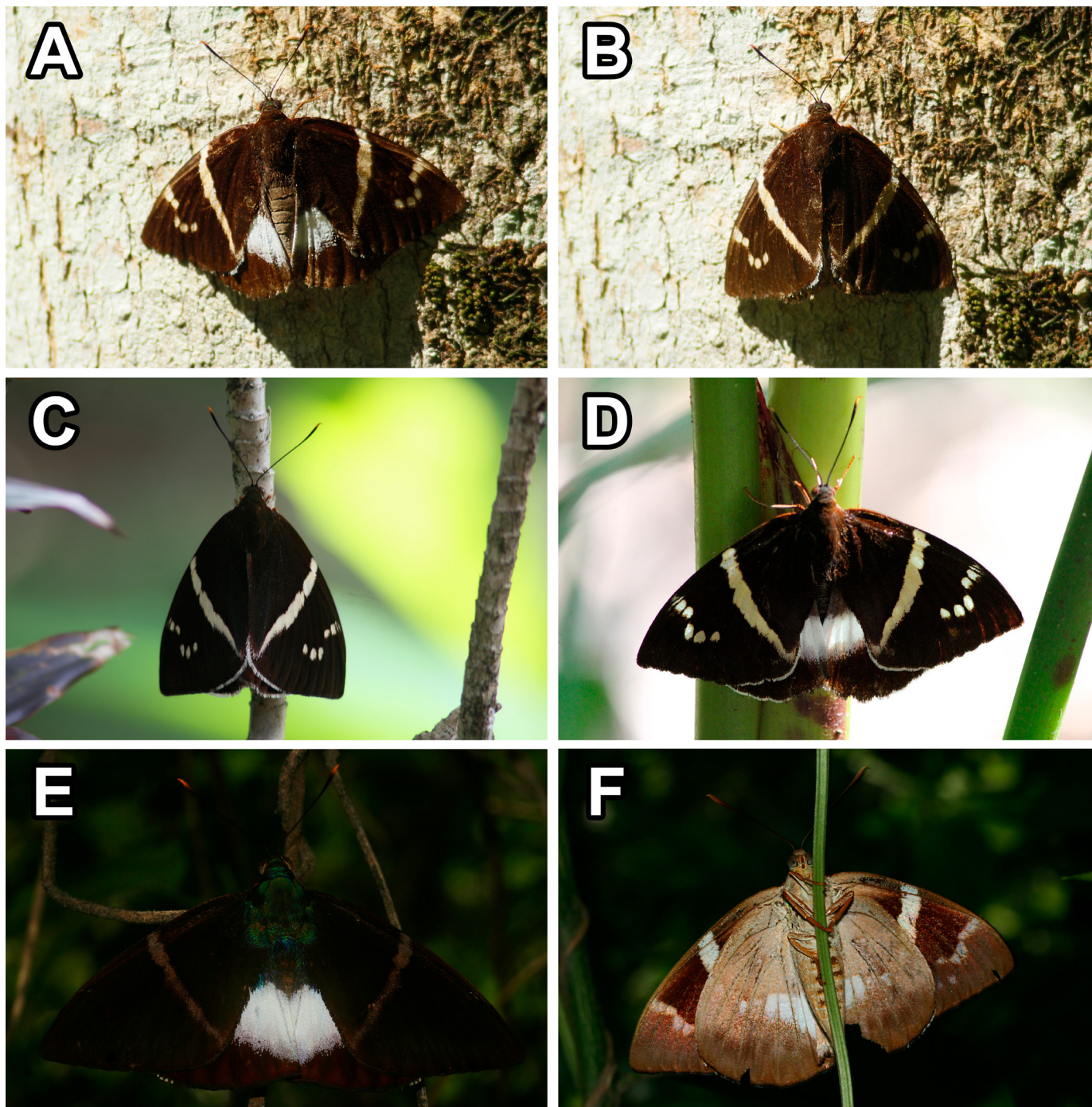


Figure 1. Males and females of *Telchin atymnius futilis* in several localities in Mexico, resting in stegopterous position. A-B) Female, dorsal view (Palenque, Chiapas, 17-I-2019, Manuel Hernández-Ancheita); C) dorsal view of a resting female (Palenque, Chiapas, 02-VIII-2018, Manuel Hernández-Ancheita); D) dorsal view of a female apparently feeding on *Heliconia* sp. (Palenque, Chiapas, 29-V-2018, Manuel Hernández-Ancheita); E) dorsal view of a male blending in with its surroundings (ADVC Koliijke, Puebla, 24-V-2009, Roberto G. de la Maza E.); F) male, ventral view (ADVC Koliijke, Puebla, 28-V-2006, Roberto G. de la Maza E.).

futilis adults have not been observed feeding on flowers, mud or decomposing fruits; however, there is a record of a female that seemed to be feeding on damaged plant tissue of a *Heliconia* sp. (Manuel Hernández-Ancheita, pers. comm.) (Fig. 1D).

Males eclose 10-20 days before females. The taxon is seldom observed on cool or cloudy days as it prefers to fly in warm and sunny surroundings. Males begin to fly at 10:00 on sunny days with temperatures that fluctuate between 22 and 28

°C, and at 11:00 on overcast days, whereas females are most frequently observed on warm days between 12:00 and 14:00. Both males and females have been occasionally observed until 17:00 on sunny days. Males become more active at higher temperatures, making frequent monitoring flights in the vicinity of their perching zone, whereas when the temperature decreases, they become less active and cease to fly. Unlike other Mexican castniid species such as *A. flavimaculata* (Miller, 1972), *A.*

hechtiae (Dyar, 1910), *A. inca* (Walker, 1854), *A. miastagma* (Dyar, 1925) or *A. thysanete* (Dyar, 1912), large numbers of specimens are not observed in a single day; typically, about 2-3 males and one female have been observed per day. Neither males nor females fly in drizzle or light rain.

Telchin a. futilis males are territorial and fly faster than *futilis* females and the majority of *Athis* species in Mexico; their flight is rapid and straight, slightly erratic. As with the great majority of Mexican castniids, male *T. a. futilis* often perch in stegopterous position on some dry twig, branch, tree trunk or on the leaves of one of its host plants to wait for a female to fly nearby (Figs. 1E, 1F, 2D). When a medium-sized or large butterfly flies near the perching zone of a male, it will be chased for several meters until they disappear and the intruder has been driven away from the zone; the male will then immediately return to (or near) the same spot where it was initially perched. Sometimes males have been observed chasing small birds. After males perch on the middle of a dry twig, they walk slowly (and with the middle pair of legs moving in a rapid 'shuffling' manner) toward the tip. If people pass nearby, they are often easily startled and can take flight and perform a patrol flight of the perching zone, or simply disappear from its initial location. On rare occasions males have attacked people who walk near them; for a few seconds they will whirl intensely near the person's body, sometimes hitting them with their wings (Roberto de la Maza, pers. comm.). Fights between males, when one invades the perching zone of another, are frequently observed. When these happen, pursuing flights take place in and out of the perching zone at different heights, up to 15 m. At the end of a fight, the winning male remains in the desired area while the loser withdraws. This can be repeated several times in a day.

Females, on the other hand, are on average larger and slightly slower than males. They are infrequently observed in April, May and June, and more commonly seen in July and August. Occasionally they can be seen resting during cloudy days or during the first hours of warm days (between 10:30 and 12:00); they can sometimes be observed perching in stegopterous position. They are often seen near one of their host plants, with the intention of ovipositing. When this occurs, they land on and flutter around the plant up to 50 cm above the ground, apparently determining where to deposit the egg; after that they land on the lower part of the plant and walk for 30 s to decide the exact spot where they will oviposit, usually close to the ground (Figs. 2A, 2B). After oviposition, they fly off in search of another plant on which to oviposit. Sometimes a female will deposit up to two eggs per plant. Females do not oviposit on plants which have already been used as host plants by another female. When the larva hatches, it makes a hole in the inferior part of the plant (usually 10 cm from the ground) and begins its life cycle inside the plant. Filiberto Mora (pers. comm.) indicates that the hole in which the larva penetrates the interior of the plant is always covered by a gelatinous substance; however, its composition is unknown. According to Lugo-Cruz *et al.* (2020), in the case of *Heliconia* spp., *T. a. futilis* larvae bore galleries in the pseudostems and corms, causing the plants to weaken; these plants display a descending pattern of withering symptoms, turning dark brown

from the apex to the base. The entrance and exit wounds and the damage to the plants favors the entry of pathogens, leading to the death of the plants a few months after the adults have emerged. When a female flies near a male, it will be chased for several meters until they disappear. The only copulation that has been documented for this taxon in Mexico was observed at the Edward James Sculpture Garden, in the vicinity of Las Pozas, Xilitla, San Luis Potosí (Fig. 2C); there, a male and a female were found copulating on a rocky path near the La Conchita stream, at 14:30 on a sunny day (Alejandro González, pers. comm.). The copulation lasted approximately 10 minutes, and most of the time the pair's heads were pointing in opposite directions in a way similar to the description by García-Díaz *et al.* (2020) for *Athis hechtiae*. During that time period the moths were mostly still, without moving, in stegopterous position. Nevertheless, on five occasions, the male (with the female attached and motionless) attempted to fly toward the vegetation but didn't succeed since they managed only small hopping flights that didn't exceed 30 cm in height and ended on the same spot where they were initially copulating. At the end of the copulation, both individuals' abdomens became detached and they flew off in different directions. The complete life cycle of the taxon remains unknown; nevertheless, it is evident that the third and fifth instar larvae resemble those illustrated by Lara (1964a), in reference to *Telchin atymnius humboldti* (Filiberto Mora, pers. comm.). Adults eclose in the morning between 9:00-10:00; after a few hours they spread their wings and begin to fly.

Material examined. Data from 193 specimens (144♂♂, 49♀♀) were recorded from the several collections under scrutiny: **Chiapas:** 1♂, VI-1997 (DC); 1♀, Ocosingo, Bonampak, VII-1964 (IBUNAM); 3♂♂, 1♀, Tapachula, Tapachula, leg. J. C. García (IBUNAM); 1♂, Marqués de Comillas, Chajul, 02-VII-1980, leg. J. de la Maza E. (CFT); 1♂, Ocosingo, Río Lacanja, Bonampak, Reserva de la Cojolita, 16°46'06"N 91°07'33"W (329 m), leg. P. Jakubek (RW); 1♀, San Quintín, 10-IX-2007 (RW); 2♂♂, Comitán, 27 km SE Santa Rosa, Rancho Santa Ana, IX-1969, leg. Peter Hubbell (YPM); 1♂, Huixtla, 08-VI-1963, leg. A. Díaz F. (CFH); 2♂♂, La Trinidad (CFH); 1♀, Marqués de Comillas, Chajul, 17-VIII-1981, leg. J. de la Maza E. (CDM); 2♂♂, Marqués de Comillas, Chajul, 17-VII-1981, leg. J. de la Maza E. (CDM); 1♂, La Concordia, Cerro Cebú, 19-VIII-2016, leg. J. de la Maza E. (CDM); 1♂, La Concordia, Cerro Cebú, 22-VIII-2015, leg. J. de la Maza E. (CDM); 1♂, La Granja, 26-VII-1930 (AMNH); **Hidalgo:** 1♀, Puerto del Caballo (high elevation cloud forest), 19-VII-1981, leg. William H. Howe (AMNH); **Oaxaca:** 1♂, San Felipe Jalapa de Díaz, 4km NE San Bartolomé Ayautla, 14-VIII-2017, leg. J. J. García D. (JJGD); 2♂♂, Santiago Comaltepec, Soyolapam, VI-1967, leg. A. Díaz F. (IBUNAM); 3♂♂, Santa María Chimalapa, Chalchijapa, 30-V-1995, leg. J. L. Salinas G. (IBUNAM); 1♂, Santa María Chimalapa, Chalchijapa, 26-V-1995, leg. J. L. Salinas G. (IBUNAM); 1♀, San Juan Bautista Valle Nacional, Valle Nacional, 11-IX-1982, leg. A. Ibarra (IBUNAM); 3♀♀, San José Chiltepec, Chiltepec, VIII-1964, leg. A. Díaz F. (IBUNAM); 1♂, Santa María Chimalapa, Chalchijapa, 27-V-1995, leg. J. L. Salinas G. (IBUNAM); 1♂, Santa María Chimalapa, Chalchijapa, 25-V-1995, leg. J. L. Salinas G. (IBUNAM); 1♂, Santiago Comaltepec, Soyolapam, V-1967, leg. A. Díaz F. (IBUNAM); 3♂♂, Santiago Comaltepec, Puerto Eligio, 07-IX-1987, leg. O. Villarreal (CFV); 1♂, San Juan Bautista Valle Nacional, Cerro La Soledad, 03-VI-1990, leg. O. Villarreal (CFV); 2♂♂, Santiago Comaltepec, Cerro Metate, 17°40'06"N 96°19'38"W (1165 m), 16-V-2008, leg. P. Jakubek (RW); 1♂, Santiago Comaltepec, Cerro Metate, 17°40'06"N 96°19'38"W (1165 m), 06-V-2006, leg. P. Jakubek (RW); 1♂, Santiago Comaltepec, Cerro Metate, 17°40'06"N 96°19'38"W (1165 m), 26-V-2006, leg. P. Jakubek (RW); 1♀, Santiago Comaltepec, Cerro Metate, 17°40'06"N 96°19'38"W (1165 m), 15-V-2006, leg. P. Jakubek (RW); 1♀, La Esperanza (1780 m), VII-2017 (RW); 1♂, 1♀, Tuxtepec, El Naranjal-Chiltepec, VIII-1969, leg. Peter Hubbell (YPM); 2♂♂, Cintalapa, La Pilar, 11-VIII-2001, leg. C. Morales L. (UNACH); 1♂,

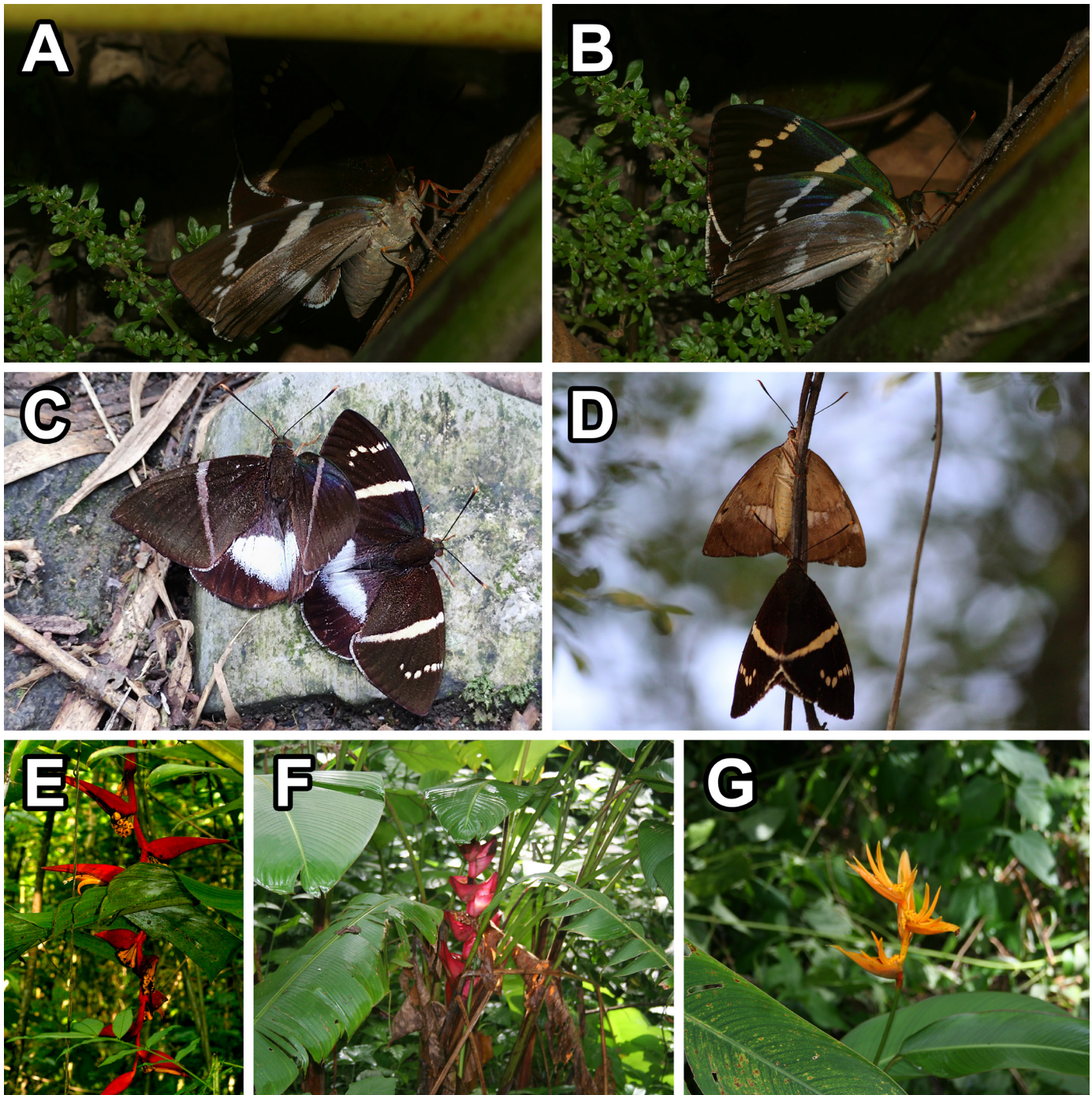


Figure 2. Aspects of *Telchin atymnius fultilis* ecology in Mexico. A-B) Female ovipositing on *Heliconia* sp. (ADVC Kolijke, Puebla, 24-V-2009, Roberto G. de la Maza E.); C) male (left) and female (right) copulating (Edward James Sculpture Garden, Xilitla, San Luis Potosí, 21-VII-2021, Alejandro González-Castillo); D) resting male (top) and female (bottom) (Palenque, Chiapas, 22-XI-2017, Manuel Hernández-Ancheita); E) *Heliconia collinsiana*, a host plant of the taxon (ADVC Kolijke, Puebla, 15-X-2010, Roberto G. de la Maza E.); F) *H. bourgaeana*, a host plant of the taxon (ADVC Kolijke, Puebla, 07-VII-2013, Roberto G. de la Maza E.); G) *H. latispatha*, a host plant of the taxon (ADVC Kolijke, Puebla, 07-VII-2013, Roberto G. de la Maza E.).

Ocozacoautla, Laguna Bélgica, 23-VIII-1991, leg. C. J. Morales (UNACH); 4♂♂, Ocozacoautla, Ocuilapa de Juárez, 22-VIII-1997, leg. C. J. Morales (UNACH); 1♀, Sierra de Juárez, Metates, VII-2013, leg. L. Haghenbeck C. (CFH); 1♂, Sierra de Juárez, Metates, VI-2000, leg. L. Haghenbeck C. (CFH); 1♂, Sierra de Juárez, Metates, 28-III-1996 (CFH); 1♂, San Felipe Jalapa de Díaz, Jalapa de Díaz, IX-2009, leg. L. Haghenbeck C. (CFH); 1♀, Tapanatepec, Las Minas, 04-VI-1979, leg. J. de la Maza E. (CDM); 1♂, Rancho San Carlos, VIII-1968, leg. Peter Hubbell (AMNH); **Puebla:** 1♂, La Ceiba, La Junta, 01-VII-2019, leg. E. Yañez (JJGD); 1♂, Zihuateutla, Barranca de Patla, 12-VIII-

2019, leg. E. Yañez (BLG); 1♂, Zihuateutla, Barranca de Patla, 11-VI-2016, leg. E. Yañez (BLG); 1♂, Venustiano Carranza, El Ajengibre, 16-V-1953 (IBUNAM); 2♂♂, Zihuateutla, Barranca de Patla, 05-IX-1978, leg. A. Ibarra (IBUNAM); 1♂, Xicotepec, Villa Juárez, 05-VI-1966, leg. C. Beutelspacher B. (IBUNAM); 1♀, Cuetzalan del Progreso, Santiago Yancuitalpan, 15-V-1982, leg. F. Mora (CFV); 1♂, San Sebastián Tlacotepec, Mazatzongo de Guerrero, 15-V-1984, leg. O. Villarreal (CFV); 1♂, Zihuateutla, ADVC Kolijke, 03-V-2020, leg. A. Turrent C. (CFT); 1♂, 1♀, Zihuateutla, ADVC Kolijke, 25-VIII-2018, leg. A. Turrent C. (CFT); 1♂, Zihuateutla, Barranca de Patla, 28-VI-



Figure 3. Geographic distribution of *Telchin atymnius futilis* in Mexico.

1998, leg. A. Turrent C. (CFT); 1♂, Zihuateutla, Barranca de Patla, 08-V-1997, leg. A. Turrent C. (CFT); 1♂, Zihuateutla, Barranca de Patla, 20-XI-1997, leg. R. Turrent D. (CFT); 1♂, Tlatlauquitepec, Presa La Soledad, 08-IX-2018, leg. A. Turrent C. (CFT); 1♀, Villa Juárez, Dos Caminos, 11-VII-2014, leg. A. Sampayo (RW); 2♂♂, Cuetzalan del Progreso, Cuetzalan, IX-1997, leg. F. G. Haghenbeck F. (CFH); 1♂, Cuetzalan del Progreso, Cuetzalan, 28-VII-1996, leg. F. G. Haghenbeck F. (CFH); 1♂, Zihuateutla, Barranca de Patla, 12-VIII-1980, leg. D. J. Curro (DJCC); 1♂, Zihuateutla, Barranca de Patla, 20-V-1974, leg. R. J. Boué Peña (IBUNAM); 1♂, Zihuateutla, Barranca de Patla, 18-V-1977, leg. R. J. Boué Peña (IBUNAM); 1♂, Zihuateutla, Barranca de Patla, 28-V-1977, leg. R. J. Boué Peña (IBUNAM); 1♂, Zihuateutla, Barranca de Patla, 27-V-1978, leg. R. J. Boué Peña (IBUNAM); 1♂, Xicotepex, Tlaxcalantongo, leg. R. J. Boué Peña (IBUNAM); 1♂, Xicotepex, Tlaxcalantongo, 18-VI-1978, leg. R. J. Boué Peña (IBUNAM); 1♂ Puebla, Tehuacán, 1000m, VII 2015 (RW) [the locality of this specimen is doubtful, since *T. a. futilis* is not present in arid ecosystems and none of its host plants is distributed in the Tehuacán-Cuicatlán Valley, see discussion below]; **San Luis Potosí:** 1♂, Tamazunchale, El Sol (400 ft), 24-VI-1941, leg. J. & R. Potts (AMNH); **Tabasco:** 1♀, Teapa, 2-VII-1964, leg. John Pallister (AMNH); **Veracruz:** 1♂, Santiago Tuxtla, El Vigía, 20-VII-1995, leg. F. G. Haghenbeck F. (JJGD); 2♂♂, Santiago Tuxtla, El Vigía, 11-VIII-2013, leg. J. J. García D. (JJGD); 1♀, Santiago Tuxtla, El Vigía, 11-VIII-2013, leg. J. J. García D. (JJGD); 1♂, Santiago Tuxtla, El Vigía, 15-VII-2017 (JJGD); 1♂, Santiago Tuxtla, El Vigía, 01-VIII-2017 (JJGD); 2♂♂, 1♀, Santiago Tuxtla, El Vigía, 20-VI-2019 (JJGD); 1♂, Santiago Tuxtla, El Vigía, 01-VII-2019 (JJGD); 4♂♂, 1♀, Santiago Tuxtla, El Vigía, 05-VII-2019 (JJGD); 1♂, 1♀, Santiago Tuxtla, El Vigía, 20-VIII-2019 (JJGD); 1♀, Santiago Tuxtla, El Vigía, 10-IX-2019 (JJGD); 1♂, San Pedro Soteapan 500m, VII/VIII-2006 (DC); 1♂, Santiago Tuxtla, El Vigía, 16-VI-2017 (BLG); 1♂, Santiago Tuxtla, El Vigía, 19-VI-2018 (BLG); 1♂, Santiago Tuxtla, El Vigía, 09-VII-2019 (BLG); 1♀, Santiago Tuxtla, El Vigía, 11-VIII-2018 (BLG); 1♂, Santiago Tuxtla, El Vigía, IV-1964, leg. R. F. de la Maza R. (IBUNAM); 2♂♂, Coatzacoalcos, Pajaritos, VII-1944, leg. R. F. de la Maza (IBUNAM); 1♂, Catemaco, Dos Amates, 15-IX-1963, leg. R. F. de la Maza (IBUNAM); 1♂, 1♀, Veracruz, Veracruz, VI-1961 (IBUNAM); 1♂, Santiago Tuxtla, El Vigía, VI-1964, leg. R. F. de la Maza R. (IBUNAM); 1♂, Orizaba, Orizaba (IBUNAM); 1♂, Catemaco, Dos Amates, X-1963, leg. R. F. de la Maza R. (IBUNAM); 1♀, Catemaco, Dos Amates, 17-X-1976, leg. A.

Ibarra (IBUNAM); 1♂, San Andrés Tuxtla, Volcán Santa Martha, 20-VI-1982 (IBUNAM); 1♀, Santiago Tuxtla, El Vigía, III-2017 (CFT); 1♂, Centro de Veracruz [possibly Orizaba], ex leg. Mario del Toro (CFT); 1♂, Santiago Tuxtla, Volcán San Martín (1200 m), VII-2005 (RW); 2♂♂, 2♀♀, San Andrés Tuxtla, Catemaco, VII-2016 (RW); 1♀, San Andrés Tuxtla, Catemaco, 18°22'36"N 95°07'35"W (345 m), 20-IX-2003, leg. P. Jakubek (RW); 7♂♂, 1♀, Dos Amates, between Catemaco and Laguna Sontecomapan, IX-1969, leg. Peter Hubbell (YPM); 2♂♂, Dos Amates, between Catemaco and Laguna Sontecomapan, X-1969, leg. Peter Hubbell (YPM); 1♂, San Andrés Tuxtla, Laguna Encantada, 03-VII-1985, leg. Robert A. Raguso (YPM); 1♀, Santiago Tuxtla, El Vigía, 15-IX-1998, leg. F. G. Haghenbeck F. (CFH); 1♀, Catemaco, Dos Amates, 04-IX-1996, leg. F. G. Haghenbeck F. (CFH); 1♀, Santiago Tuxtla, El Vigía, 03-X-2013 (CFH); 3♀♀, Santiago Tuxtla, El Vigía, VI-1996, leg. F. G. Haghenbeck F. (CFH); 1♀, Atoyac, 11-VI-1987, leg. F. G. Haghenbeck F. (CFH); 2♂♂, Santiago Tuxtla, El Vigía, 03-VI-2002, leg. F. G. Haghenbeck F. (CFH); 5♂♂, Santiago Tuxtla, El Vigía, 21-III-1997 (CFH); 1♀, Dos Amates, Catemaco, 19-IX-1970, R. F. de la Maza R. (CDM); 1♀, Santiago Tuxtla, El Vigía, 15-VIII-1963, R. F. de la Maza R. (CDM); 1♂, Santiago Tuxtla, El Vigía, 12-IX-1964, R. F. de la Maza R. (CDM); 1♂, Dos Amates, Catemaco, 18-VI-1965, R. F. de la Maza R. (CDM); 1♂, Dos Amates, Catemaco, 07-VI-1964, R. F. de la Maza R. (CDM); 1♂, Dos Amates, Catemaco, 07-VI-1964, R. F. de la Maza R. (CDM); 6♂♂, 2♀♀, Coatzacoalcos, Pajaritos, VII-1944, M. Guerra Coll., Frank Johnson Donor (AMNH); 1♂, Tezonapa, Tezonapa, XI, W. L. Tower Collection (AMNH); 1♂, Km. 25 sureste, VII-1944, M. Guerra Coll., Frank Johnson Donor (AMNH); 1♂, Presidio, V-1940, leg. C. C. Hoffmann (AMNH); 1♂, Presidio, VIII, leg. C. C. Hoffmann (AMNH); 1♂, Orizaba, VII-1907, leg. C. C. Hoffmann (AMNH); 2♂♂, Presidio, VIII-1913, leg. C. C. Hoffmann (AMNH); 1♂, Jalapa, Collection Hy. Edwards (AMNH); 1♂, Misantla, VI-1909, leg. C. C. Hoffmann (AMNH); 1♂, Presidio, IX-1939, leg. C. C. Hoffmann (AMNH); 1♀, Presidio, IX-1940, leg. C. C. Hoffmann (AMNH); 1♀, No. 2887, Presidio, leg. R. Müller (MHNCM); 1♀, No. 2888, Mirador, leg. R. Müller (MHNCM); 1♂, No. 2701, Mirador, leg. R. Müller (MHNCM); 1♂, No. 2700, Orizaba, leg. R. Müller (MHNCM). Additionally, seven specimens were analyzed without information on their locality: 1♂, Mexico, 2-91 (DC); 1♀, Mexico, leg. Paul Buxbaum (YPM); 2♂♂, 2♀♀, Mexico, Friedrich Hist. Coll. (MfNB); 1♀, leg. R. J. Boué Peña (IBUNAM).

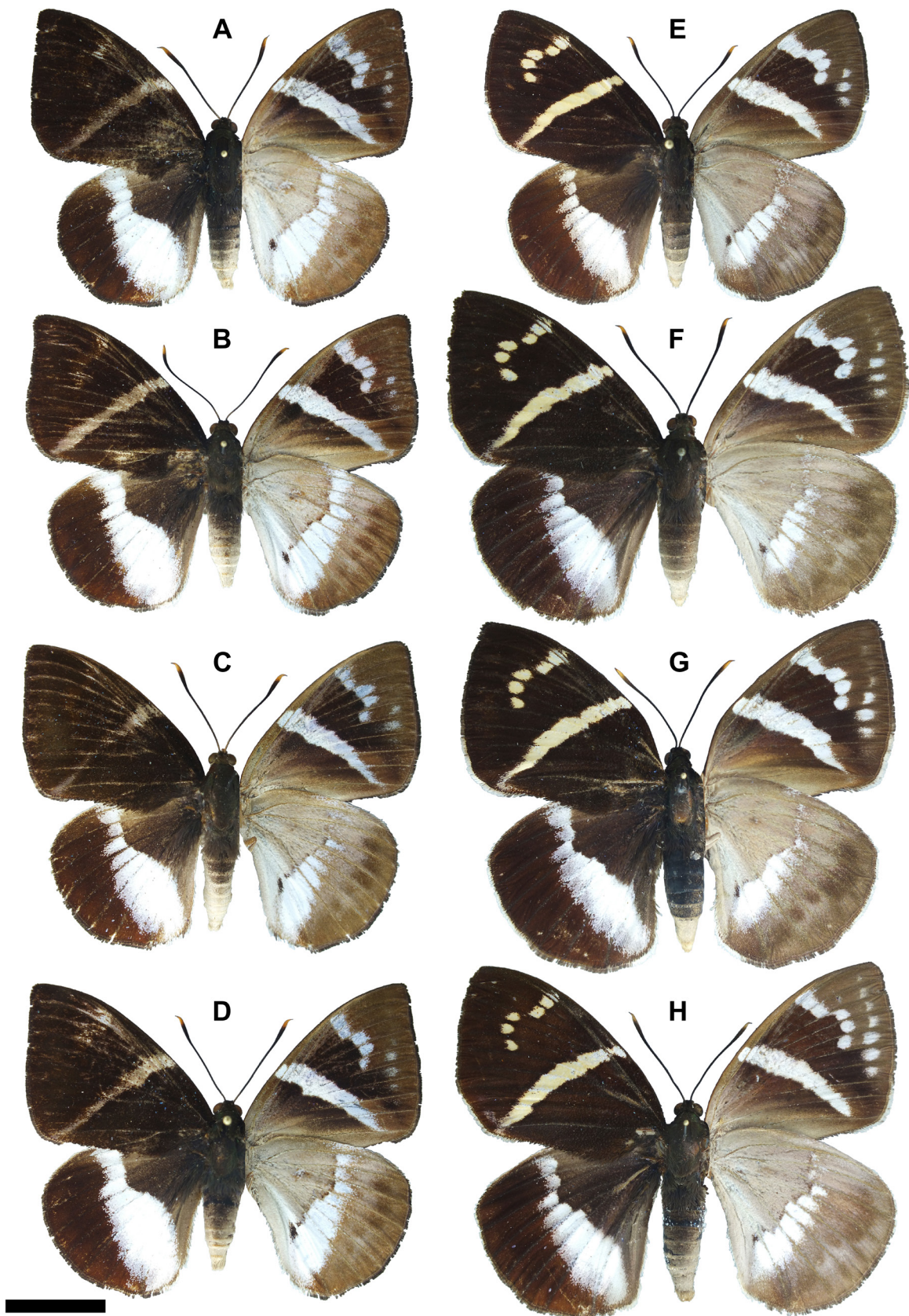


Figure 4. Dorsal (left) and ventral (right) variation of *Telchin atymnius futilis* males (A-D) and females (E-H). A) Male from Veracruz, Santiago Tuxtla, El Vigía, 20-VI-2019 (JJGD); B) male from Veracruz, Santiago Tuxtla, El Vigía, 20-VI-2019 (JJGD); C) male from Oaxaca, San Felipe Jalapa de Díaz, 4 km NE San Bartolomé Ayautla, 14-VIII-2017, leg. J. J. García D. (JJGD); D) male from Veracruz, Santiago Tuxtla, El Vigía, 01-VII-2019 (JJGD); E) female from Veracruz, Santiago Tuxtla, El Vigía, 10-IX-2019 (JJGD); F) female from Veracruz, Santiago Tuxtla, El Vigía, 11-VIII-2013, leg. J. J. García D. (JJGD); G) female from Veracruz, Santiago Tuxtla, El Vigía, 20-VIII-2019 (JJGD); H) female from Veracruz, Santiago Tuxtla, El Vigía, 20-VI-2019 (JJGD). Scale bar = 2 cm.

Variation. This castniid subspecies exhibits clear sexual dimorphism but little variation within each sex (Fig. 4). In addition to size, the main difference between males and females can be seen in dorsal view: on the forewings, the subapical spot band is always present in females, never (or barely suggested) in males; the diagonal band is often slightly wider in females. Ventrally, the main difference can be observed on the hindwings: the white band is wider in males, mainly near the costal margin.

Concerning variation between individuals, in some males, dorsally, the nearly imperceptible forewing costal band disappears completely. In both males and females, the forewing diagonal band and the hindwing white band exhibit variations in each specimen on both surfaces; some specimens have a narrowed white band (dorsal view) near the costal margin. Ventrally, the length and width of the submarginal spots on the forewings is variable in both sexes.

DISCUSSION

Telchin atymnius futilis is a very common taxon, frequently observed in Mexico and Central America (Miller, 2000; González, 2008; González & Hernández-Baz, 2012; van den Berghe *et al.*, 2020). Considering the taxon's presence in the Mexican states mentioned by Morales-Morales *et al.* (2015), the records in this work for Campeche, Hidalgo, Oaxaca, Puebla, Querétaro, San Luis Potosí and Tabasco constitute new state records which broaden considerably its known distribution in the country. Of all the castniid species in Mexico, the complete range of this subspecies seems to be evolving relatively recently, which agrees with what was noted by Miller (1986). This suggestion is supported by the following facts: (1) it is not endemic to the country, thus its distribution is not restricted to Mexico; (2) north of the Isthmus of Tehuantepec, it is only distributed on the Gulf slope, whereas south of the Isthmus it is distributed on both slopes (and in both cases without presenting subspeciation); (3) it does not occur in arid regions, unlike other castniid species in the country; (4) it does not have a sister species on the Pacific slope of the Sierra Madre del Sur or the Balsas River basin, since these regions would seem to be natural barriers that prevent its expansion toward the northern Pacific regions. *Telchin evalthe viryi* and *Telchin diva diva* are two taxa with a distribution relatively similar to that of *T. atymnius futilis*; however, the latter's distribution is more northerly.

Its broad distribution on the Gulf of Mexico slope could be explained by its high food adaptive plasticity, because nine host plant species belonging to three genera (*Heliconia*, *Canna* and *Etilingera*) are known for this subspecies in Mexico. It is worth noting that one of the host plants, *Etilingera elatior*, is Asiatic in origin (Juwita *et al.*, 2018) and *Heliconia rostrata* is native to South America (Banerjee *et al.*, 2020); however, the latter species has been recorded growing wild in Chiapas, in the Chajul region (Santos *et al.*, 2009). Additionally, some subspecies of *Telchin atymnius* have been recorded to feed on sugar cane (*Saccharum officinarum*: Poaceae) (Aya *et al.*, 2021), with *T. a. futilis* being one of them (Miller, 2000; González *et al.*, 2010; González & Domagała, 2019; van den Berghe *et al.*, 2020). In Costa Rica, *Telchin licus* (Drury, 1773) has been recorded as an important pest of sugarcane monocultures in

some localities of the country (Coto & Saunders, 2004; LAICA, 2016). However, it has recently been confirmed that the taxa studied in these works correspond to *T. a. futilis* and *T. a. drucei* (LAICA, 2017; Salazar-Blanco *et al.*, 2018; Cadet-Piedra *et al.*, 2019; José Daniel Salazar, pers. comm.). This type of confusion is frequent between subspecies of *T. licus* and *T. atymnius*, which has resulted in misidentifications in various works (Aya *et al.*, 2021). Curiously, *futilis* and *drucei* fly together in sugar cane fields in the region of San Carlos, Huetar Norte, Costa Rica (where both taxa have been collected) (LAICA, 2016; José Daniel Salazar, pers. comm.). Miller (2000) comments that *Telchin atymnius* also feeds on banana tree (*Musa* spp.: Musaceae) but doesn't specify whether *futilis* feeds on that plant. The remarks by González *et al.* (2010), González & Domagała (2019) and van den Berghe *et al.* (2020) concerning the banana tree (*Musa* spp.) as the host plant of *Telchin atymnius futilis* come from Miller (2000); however, there are no other publications documenting this subspecies' host plant associations. Considering the above mentioned, it is evident that there has been confusion concerning some host plants of this subspecies. However, by examining the information provided in the present work together with the cited bibliography, it can be inferred that *T. atymnius* is a species that does feed on *Saccharum officinarum* and that the subspecies *T. a. futilis* does not feed on nor attack *Musa* spp. monocultures. It is curious that the preference of this subspecies for sugar cane has not, to date, been documented in Mexico. The great number of *Heliconia* species in the country on the Gulf slope may explain why it has not required a similar adaptation. *Telchin atymnius futilis* is, without doubt, the Mexican castniid with the greatest number of host plant species. There is also the possibility that it uses other hostplants, especially Heliconiaceae native to Mexico and Central America.

Among the specimens studied for this work, the record of *T. atymnius futilis* from Tehuacán, Puebla, seems doubtful because: (1) it is the only record in which the collecting locality is not within a humid region such as rainforest, semideciduous forest or cloud forest; (2) the Tehuacán-Cuicatlán Valley is an arid region with a high degree of endemism, located south of the Trans-Mexican Volcanic Belt and which has xeric scrublands vegetation in its northern part and deciduous forest in the south (Rzedowski, 1973, 1978; Canseco-Márquez & Gutiérrez-Mayén, 2010; Rojas *et al.*, 2013; García-Díaz *et al.*, 2021); (3) there are no records of any of its host plants in the Tehuacán-Cuicatlán Valley (Valiente-Banuet *et al.*, 2009; Bolaños-Bautista & González-Bernal, 2016). Similar cases of doubtful or erroneous information on Lepidoptera have been noted by De la Maza-Elvira *et al.* (2017), García-Díaz & Turrent-Carriles (2019) and González *et al.* (2021), among others.

Unlike other castniid species with distribution in Mexico, such as *Athis hechtiae*, *A. thysanete*, *Escalantiana chelone* (Hopffer, 1856) or *Mexicastnia estherae* (Miller, 1976), *Telchin atymnius futilis* is not narrowly distributed within the country; thus, it is likely less vulnerable than those other species. In addition, it has nine confirmed host plants in Mexico. However, some of its populations might be affected in various parts of the country due to deforestation. Host plants of *T. atymnius futilis* are, for the most part, ornamental plants that thrive in

different types of forest thus helping prevent local extinctions of this subspecies and, at the same time, helping to broaden its distribution in Mexico.

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LITERATURE CITED

- Aya, V. M., Pabón, A., González, J. M., Vargas, G. 2021. Morphological and molecular characterization of Castniidae (Lepidoptera) associated to sugarcane in Colombia. *Bulletin of Entomological Research* 1-12.
- Banerjee, A., Islam, S., Panja, B. N., Nath, P. S. 2020. First report of *Colletogloeum* sp. as the causal agent of marginal leaf blight on *Heliconia rostrata* in India. *New Disease Reports* 41: 31.
- Bolaños-Bautista, E., González-Bernal, J. A. 2016. *Flora de Tehuacán: Especies y modos de convivencia*. CRETEALC-México. Tonantzintla, Puebla, México.
- Cadet-Piedra, E., Salazar-Blanco, J. D., Oviedo-Alfaro, R. 2019. Monitoreo y manejo del barrenador gigante del tallo de la caña de azúcar (*Telchin atymnius* Lepidoptera: Castniidae) en Costa Rica. *Boletín Agroclimático* 1(12): 5-8.
- Canseco-Márquez, L., Gutiérrez-Mayén, M. G. 2010. *Anfibios y Reptiles del Valle de Tehuacán-Cuicatlán*. México, Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, Fundación para la Reserva de la Biósfera Cuicatlán, A.C., & Benemérita Universidad Autónoma de Puebla. xvi + 103 pp.
- Coto, D., Saunders, J. L. 2004. *Insectos plagas de cultivos perennes con énfasis en frutales en América Central*. Turrialba, CATIE. 257 pp.
- Druce, H. 1881-1900. *Insecta. Lepidoptera-Heterocera*, 1 & 3, pp. 1-490 & pls. 1-101. In: Godman, F. D. & Salvin, O. (Eds.), *Biologia Centrali-Americana; or Contributions to the Knowledge of the Fauna of Mexico and Central America*.
- Gallego, F. L. 1946. Catálogo de insectos correspondientes a la Orden Lepidoptera existentes en la sección de Entomología de la Facultad Nacional de Agronomía, Medellín. Parte II. Nocturnas, Heterocera o Chalinoptera. *Revista de la Facultad Nacional de Agronomía* 6(24): 415-471.
- Gallego, F. L. 1963. Superfamilia Castnioidea (Castnioidea Handlirsch. 1925). *Revista de la Facultad Nacional de Agronomía* 23(58): 22-44.
- García-Díaz, J. J., Turrent-Carriles, A. 2019. Redescubrimiento de *Agathymus escalantei* D. Stallings, Turner & V. Stallings, 1966 (Hesperiinae-Megathymini) y descripción del macho. *Revista de la Sociedad Mexicana de Lepidopterología (Nueva Serie)* 6(2): 36-45.
- García-Díaz, J. J., Turrent-Carriles, A., Warren, A. D. 2021. *Panoquina luctuosa luctuosa* (Herrich-Schäffer, 1869): a new record for Mexico (Lepidoptera: Hesperiidae: Hesperiinae). *Tropical Lepidoptera Research* 31(1): 1-6.
- García-Díaz, J. J., López-Godínez, B., Turrent-Carriles, A. 2019. Descripción de la hembra de *Athis jaliscana* López y Porion, 2012 (Castniidae) con algunos comentarios bionómicos. *Revista de la Sociedad Mexicana de Lepidopterología (Nueva serie)* 7(1): 35-41.
- García-Díaz, J. J., Miller, J. Y., González, J. M. 2020. Observations on the courtship and other biological aspects of *Athis hechtiae* (Dyar, 1910) (Castniidae) in Tehuacán, Puebla, Mexico. *Tropical Lepidoptera Research* 30(2): 86-89.
- González, J. M. 2008. *Castnidos (Lepidópteros)*, pp. 1-4, 169-170. In: Ocegueda, S., Llorente, J. (Coords.), *Catálogo taxonómico de especies de México, en Capital natural de México. Vol. I. Conocimiento actual de la biodiversidad*. México, CONABIO.
- González, J. M., Cock, M. J. W. 2004. A synopsis of the Castniidae (Lepidoptera) of Trinidad and Tobago. *Zootaxa* 762: 1-19.
- González, J. M., Domagala, P. 2019. A catalog of the Castniidae (Lepidoptera) in the California Academy of sciences with general and historical comments. *Annals of the Upper Silesian Museum in Bytom, Entomology* 28: 1-24.
- González, J. M., Hernández-Baz, F. 2012. *Polillas y taladradores gigantes de la familia Castniidae (Lepidoptera) de Guatemala*, pp. 145-153. In: Cano, E. B., Schuster, J. C. (Eds.), *Biodiversidad de Guatemala. Vol. 2*. Guatemala, Universidad del Valle de Guatemala.
- González, J. M., Boone, J. H., Brilmyer, G. M., Le, D. 2010. The Giant Butterfly-moths of the Field Museum of Natural History, Chicago, with notes on the Herman Strecker collection (Lepidoptera: Castniidae). *SHILAP Revista de Lepidopterología* 38(152): 385-409.
- González, J. M., Gonzalo-Andrade, C. M., Worthy, R., Hernández-Baz, F. 2017. Giant butterfly moths of the Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá, Colombia (Lepidoptera: Castniidae). *SHILAP Revista de Lepidopterología* 45(179): 447-456.
- González, J. M., López-Godínez, B., García-Díaz, J. J., Simon, S., Sarto i Montey, V., Worthy, R. 2021. Reinstatement of *Athis miastagma* (Dyar, 1925) (Lepidoptera: Castniidae) as a valid species inhabiting the Pacific slope of Central Mexico. *Zootaxa* 5061(2): 300-322.
- Houlbert, C. 1918. *II. Révision monographique de la Sous-Famille des Castniinae*, pp. 5-713, 437-462 pls. In: Oberthür, C. (Ed.), *Études de Lépidoptérologie comparée, Fascicle XV. Imprimerie Oberthür*. Rennes, Author.
- Juwita, T., Melyani-Puspitasari, I., Levita, J. 2018. Torch Ginger (*Elingera*

- elator*): A review on its botanical aspects, phytoconstituents and pharmacological activities. *Pakistan Journal of Biological Science* 21(4): 151-165.
- LAICA.** 2016. *Trampeo de adultos de Castnia licus en su comportamiento diurno y orientación visual como estrategia reproductiva*, pp. 43-48. Costa Rica, Programa de Fitosanidad, Manejo de Plagas (Informe de resultados 2015).
- LAICA.** 2017. *Identificación y reclasificación taxonómica del barrenador gigante de la caña de azúcar*, pp. 6-8. Costa Rica, Programa de Fitosanidad, Manejo de Plagas (Informe de resultados 2016).
- Lamas, G.** 1995. A critical review of J. Y. Miller's checklist of the Neotropical Castniidae (Lepidoptera). *Revista Peruana de Entomología* 37: 73-87.
- Lara, F.** 1964a. The banana stalk borer *Castniomera humboldti* (Boisduval) in La Estrella Valley, Costa Rica. I. Morphology. *Turrialba* 14(3): 128-134.
- Lara, F.** 1964b. The banana stalk borer *Castniomera humboldti* (Boisduval) in La Estrella Valley, Costa Rica. II. Bionomics. *Turrialba* 14(4): 188-195.
- Lara, F.** 1965. The banana stalk borer *Castniomera humboldti* (Boisduval) in La Estrella Valley, Costa Rica. III. Rhythms and Ecology. *Turrialba* 15(2): 99-102.
- Lara, F.** 1966a. The banana stalk borer *Castniomera humboldti* (Boisduval) in La Estrella Valley, Costa Rica. IV. Sampling method. *Turrialba* 16(1): 29-32.
- Lara, F.** 1966b. The banana stalk borer *Castniomera humboldti* (Boisduval) in La Estrella Valley, Costa Rica. V. Cultural control. *Turrialba* 16(2): 136-138.
- López-Godínez, B., Porion, T.** 2012. Notes sur le genre *Athis* Hübner, [1819] et description d'une nouvelle espèce du Mexique (Lepidoptera, Castniidae). *Les cahiers du Musée des Confluences - Études scientifiques* 3: 75-81.
- Lugo-Cruz, E., Rivero-Bautista Del, N., Sánchez-Soto, S., Osorio-Osorio, R., Romero-Nápoles, J.** 2020. Insectos fitófagos asociados a cultivos de heliconias (*Heliconia* spp.) en Tabasco, México. *Agroproductividad* 13(2): 31-36.
- Maza-Elvira, R. G. De la, Maza-Elvira, J. De la, Turrent-Díaz, R.** 2017. *Mariposas Mexicanas: Una Historia de 200 Años*. Ciudad de México, Natura Mexicana.
- Miller, J. Y.** 1986. *The Taxonomy, Phylogeny, and Zoogeography of the Neotropical Castniidae (Lepidoptera: Castnoidea: Castniidae)*. Ph.D. Thesis. Gainesville, University of Florida. 571 pp.
- Miller, J. Y.** 1995. *Castnoidea: Castniidae: Castniinae*, pp. 133-137. In: Heppner, J. B. (Ed.), *Checklist: part 2. Hyblaeoidea-Pyraloidea-Tortricoidea. Atlas of Neotropical Lepidoptera*. Gainesville, Association for Tropical Lepidoptera and Scientific Publishers.
- Miller, J. Y.** 2000. *Castniidae (Lepidoptera)*, pp. 527-531. In: Llorente B., J, González S., E., Papavero, N. (Eds.), *Biodiversidad, taxonomía y biogeografía de artrópodos de México: hacia una síntesis de su conocimiento. Vol. II*. México, CONABIO.
- Moraes, S. S., Duarte, M.** 2009. Morfologia externa comparada das três espécies do complexo *Telchin licus* (Drury) (Lepidoptera, Castniidae) com uma sinonímia. *Revista Brasileira de Entomologia* 53: 245-265.
- Moraes, S. S., Duarte, M.** 2014. Phylogeny of Neotropical Castniinae (Lepidoptera: Cossoidea: Castniidae): testing the hypothesis of the mimics as a monophyletic group and implications for the arrangement of the genera. *Zoological Journal of the Linnean Society* 170(2): 362-399.
- Morales-Morales, C. J., Guevara-Hernández, F., Gómez-Castañeda, J. C., Espinosa-Moreno, J. A., Gutiérrez-Martínez, A.** 2015. Cástnidos depositados en la Colección Entomológica de la Facultad de Ciencias Agronómicas (UN.A.CH.), Villaflores, Chiapas (Lepidoptera: Castniidae). *Dugesiana* 22(1): 65-66.
- Rojas, S., Castillejos-Cruz, C., Solano, E.** 2013. Florística y relaciones fitogeográficas del matorral xerófilo en el Valle de Tecozautla, Hidalgo, México. *Botanical Sciences* 91(3): 273-294.
- Rzedowski, J.** 1973. *Geographical relationships of the flora of Mexican dry regions*, pp. 61-72. In: Graham, A. (Ed.), *Vegetation and Vegetational History of Northern Latin America*. Amsterdam, Elsevier Science Publication Company.
- Rzedowski, J.** 1978. *Vegetación de México*. México, Limusa.
- Salazar-Blanco, J. D., Cadet-Piedra, E., Oviedo-Alfaro, R., Berrocal-Kopper, R., Araya-Vindas, A.** 2018. *Monitoreo y manejo del barrenador gigante del tallo de la caña de azúcar (Telchin atymnius Lepidoptera: Castniidae) en Costa Rica*, p. 87. In: *Resumen XI Congreso ATALAC - TECNICAÑA. 26 - 28 de Setiembre de 2018*. Cali.
- Santos, B. A., Lombera, R., Benitez-Malvido, J.** 2009. New records of *Heliconia* (Heliconiaceae) for the region of Chajul, Southern Mexico, and their potential use in biodiversity-friendly cropping systems. *Revista Mexicana de Biodiversidad* 80: 857-860.
- Shorthouse, D. P.** 2010. *SimpleMappr: an online tool to produce publication-quality point maps*. <http://www.simplemappr.net>. Accessed 30 October 2021.
- Valiente-Banuet, A., Solís, L., Dávila, P., Arizmendi, M. C., Silva-Pereyra, C., Ortega-Ramírez, J., Treviño-Carreón, J., Rangel-Landa, S., Casas, A.** 2009. *Guía de la vegetación del Valle de Tehuacán-Cuicatlán*. México, Impresora Transcontinental.
- van den Berghe, E., Maes, J. M., Hernández-Baz, F., González, J. M.** 2020. Synopsis of the Castniidae (Lepidoptera) from Honduras and Nicaragua, Central America. *Zootaxa* 4895(2): 272-284.
- Vinciguerra, R., Lozano-Rodríguez, P., Hernández-Baz, F., González, J. M.** 2011. Observations on *Athis thysanete* (Dyar, 1912) (Lepidoptera: Castniidae) from Mexico, with comparative notes on other species in the family. *Biodiversity Journal* 2(4): 189-194.
- Westwood, J. O.** 1877. A Monograph of the Lepidopterous genus *Castnia* and some allied groups. *Transactions of the Linnean Society of London, Zoology* 2(1): 155-207, pls. 28-33.
- Worthy, R., González, J. M., Lamas, G.** 2017. A review of the genus *Haemonides* Hübner, [1819] (Lepidoptera: Castniidae). *Zootaxa* 4320(2): 245-271.