

Alive and kicking in Central America and the Riviera Maya: first reports of *Papilio demoleus* Linnaeus, 1758 in Panama, Costa Rica, and Mexico, with a warning to their citrus producers (Lepidoptera: Papilionidae)

José de Jesús García-Díaz & Jorge M. González

Abstract

Papilio demoleus malayanus Wallace, 1865 is reported for the first time in Mexico, based on four specimens collected in Cancún, Quintana Roo, and 11 additional observations from the state Quintana Roo, documented on the citizen science platform iNaturalist.org. This species is a recognized pest of citrus crops, and its monitoring is recommended to prevent its spread within the country and to mitigate potential economic impacts on the citrus industry. Furthermore, records of this species from other countries in the Americas are presented, based on citizen researchers' observations uploaded in iNaturalist.org, including the first documented records for Costa Rica and Panama. Two new host plants are reported for *Papilio demoleus*, and various aspects of its ecology are discussed. Lastly, the importance of iNaturalist.org as an effective platform for detecting rare species, Lepidoptera pests, and other taxonomic groups is emphasized.

Key words: Lepidoptera, Papilionidae, citrus pest, geographic distribution, iNaturalist.org, invasive species, Neotropical.

Vivitos y coleando en Centroamérica y la Riviera Maya: primeros reportes de *Papilio demoleus* Linnaeus, 1758 en Panamá, Costa Rica y México, con una advertencia a sus citricultores (Lepidoptera: Papilionidae)

Resumen

Papilio demoleus malayanus Wallace, 1865 es reportado por primera vez en México, basados en cuatro ejemplares recolectados en Cancún, Quintana Roo, además de 11 observaciones adicionales en el estado de Quintana Roo, documentadas en la plataforma de ciencia ciudadana iNaturalist.org. Esta especie es una plaga reconocida en los cultivos de cítricos, por lo que se recomienda su monitoreo para evitar su dispersión en el país y mitigar posibles impactos económicos en la industria citrícola. Además, se presentan registros de la especie en otros países de las Américas, basados en observaciones de investigadores ciudadanos incluidas en iNaturalist.org, incluyendo los primeros registros documentados para Costa Rica y Panamá. Se reportan dos nuevas plantas hospederas para *Papilio demoleus* y se discuten varios aspectos de su ecología. Por último, se destaca la importancia de iNaturalist.org como plataforma eficaz para la detección de especies raras, plagas de Lepidoptera y otros grupos taxonómicos.

Palabras clave: Lepidoptera, Papilionidae, distribución geográfica, especie invasora, iNaturalist.org, plaga de los cítricos, Neotropical.

Introduction

Papilionidae is one of the best-studied families of Lepidoptera. They are easily recognized by having a medium to large size and being conspicuous, although there are species of reduced size, such as those of the subfamilies Baroniinae and Parnassiinae (DeVries, 1987; Tyler et al. 1994; James & Lohman, 2024). Their distribution is preeminently tropical but several species are found in temperate regions, making this large group of Papilionoidea, with over 600 species, almost cosmopolitan (Nieukerken et al. 2011; Yu et al. 2023; James & Lohman, 2024). According to De la Maza-Elvira & De la Maza-Elvira (2022), 73 species and 64 subspecies of Papilionidae are known from Mexico, about 12% of the total number of species estimated worldwide. Of these, 18 species and 46 subspecies seem to be endemic to Mexico (De la Maza-Elvira & De la Maza-Elvira, 2022). After two years of thorough research in Quintana Roo, De la Maza-Elvira & Gutierrez-Carbonell (1992) identified 22 species of Papilionidae. They highlighted the importance of investigating flooded and coastal areas to determine whether species from the Antilles are merely passing through or have already established themselves in the peninsula. Some doubtful and unconfirmed records of Papilionidae exist from the country, such as *Battus belus chalceus* (Rothschild & Jordan, 1906) [= *Battus belus varus* (Kollar, 1850)] from Central and South America, or the North American species *Parnassius smintheus* Doubleday, 1847 and *Pterourus glaucus* (Linnaeus, 1758) (De la Maza-Ramírez, 1987; Tyler et al. 1994; De la Maza-Elvira & De la Maza-Elvira, 2022). However, to date no swallowtails from other continents had been reported in Mexico.

Papilio demoleus Linnaeus, 1758 is a tailless species of Asian origin and it is perhaps the most widely distributed in the world (Collins & Morris, 1985; Morgun & Wiemers, 2012). It is commonly known as checkered swallowtail, lime butterfly, lime swallowtail, lemon butterfly, and citrus swallowtail (Riaz et al. 2020). According to Smith & Vane-Wright (2008) and Nielsen (2017), five subspecies are recognized: *P. demoleus demoleus*, *P. d. malayanus* Wallace, 1865, *P. d. novoguineensis* Rothschild, 1908, *P. d. sthenelinus* Rothschild, 1895 and *P. d. sthenelus* Macleay, 1826. The nominotypical subspecies and *P. demoleus malayanus* are known to be invasive Papilionidae of economic importance as pests of citrus (Guerrero et al. 2004; Garraway et al. 2009; Riaz et al. 2020). Originally, the five subspecies had disjunct distributions (Morgun & Wiemers, 2012); however, the rapid expansion of *P. d. demoleus* and *P. d. malayanus* in several Asian countries since the late 1950s, unified their distribution, with the consequent overlapping of some subspecies (Moonen, 1991; Matsumoto, 1996, 2002; Benyamini et al. 2007; Smith & Vane-Wright, 2008; Morgun & Wiemers, 2012). *Papilio demoleus* has also spread along the Mediterranean region and Europe, and populations are present in Syria and Turkey, including an isolated record in Portugal (Morgun & Wiemers, 2012; Başbay et al. 2020).

Interestingly, *P. demoleus malayanus* was recorded for the first time in the Americas in Hispaniola (Dominican Republic) by Guerrero et al. (2004). After morphological comparisons and analyzing several genetic markers, Eastwood et al. (2006) confirmed that the individuals of this population originated from Southeast Asia, after a single introduction. Subsequently, this taxon had spread in the Caribbean, and it is now known from Puerto Rico, Jamaica, Bahamas, Cuba, and Haiti (Homziak & Homziak, 2006; Núñez-Águila, 2007; Wehling et al. 2006; Garraway et al. 2009; Segarra-Carmona et al. 2010; Bastardo, 2012; Fernández-Hernández & Minno, 2015; Yong et al. 2018; Riaz et al. 2020). Hayden et al. (2022) published a pest alert for the United States on *P. demoleus* based on the photographs of two larvae found in Key West, Florida, and shown on the iNaturalist.org platform.

In late December 2024, the first author (JJGD) was contacted separately by two Mexican lepidopterologists, who informed him that they had collected specimens of *Papilio demoleus* in Cancún, Quintana Roo, Mexico. These atypical records prompted JJGD to check the iNaturalist.org platform to investigate whether there had been observations of the species within Mexico. Surprisingly, there were 11 additional observations from 15 October 2022 to the moment we wrote this note, all from the state of Quintana Roo. After a more detailed exploration within the platform, 496 records were found in 16 North and Central American countries and several Caribbean islands. Among these reports, the first records of the presence of *P. demoleus*, were found in Costa Rica and Panama. Such findings motivated the authors to write the present not only to expand the knowledge on *P. demoleus* in the Americas but also to emphasize the relevance of the platform iNaturalist.org as a valuable tool for studying biodiversity.

Materials and methods

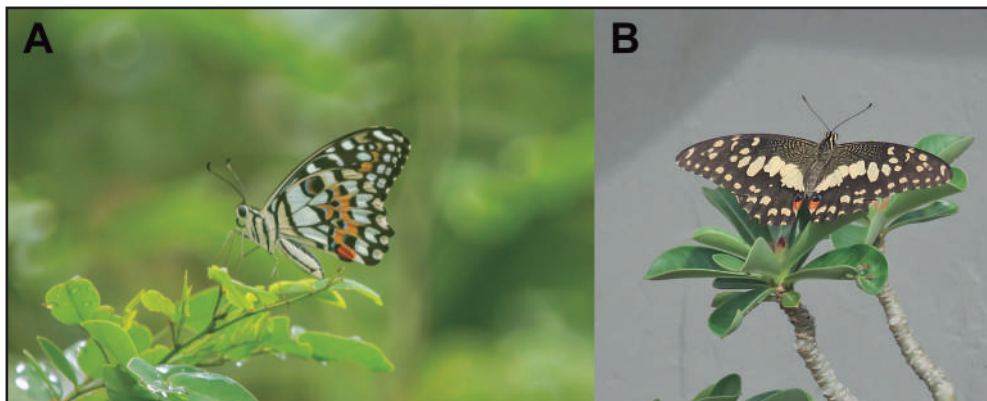
Three specimens collected by Carlos Velázquez on 23-XII-2024 and one specimen collected by Shuster Alberto Nah on 26-XII-2024 are provided as evidence of the presence of *P. demoleus* in the Yucatán Peninsula, in Mexico (Figure 1). Two specimens are deposited at the collection of Carlos Velázquez and two are now part of the research material of JJGD. The photograph of the specimen in Figure 1 was taken with a Fujifilm FinePix HS20EXR camera.

Figure 1. *Papilio demoleus* ♂, Cancún, Quintana Roo, Mexico, 26-XII-2024, leg. Shuster Alberto Nah. Scale bar = 1cm.



The distribution of *Papilio demoleus* in the Americas was determined thanks to the existing observations provided by numerous citizen scientists into the iNaturalist.org (2025) platform. All records within this platform were carefully checked and corroborated to avoid repeating data and detecting misidentifications; information published up to 12-I-2025 was included.

Figure 2. Live adults of *Papilio demoleus* in Quintana Roo, Mexico. **A.** Tulum municipality, 04-X-2024 (photo: Elias Siebenborn; <https://inaturalist.org/observations/246329072>); **B.** Benito Juárez municipality, 13-X-2024 (photo: Evangelina Améndola; <https://inaturalist.org/observations/247121479>).



The distribution map (Figure 4) was produced by using the SimpleMappr tool (Shorthouse, 2010). The plots in Figure 3 were produced in R software (R Core Team, 2023), and their editing was enhanced using the “ggplot2” package (Wickham, 2016). Adobe Photoshop 2020 was used to edit the figures.

Results and discussion

When comparing the Mexican specimens with those illustrated by Guerrero et al. (2004), Nielsen (2017), and Smith & Vane-Wright (2008), they seem to correspond to the subspecies *P. demoleus malayanus*, the only one reported so far for the Americas. Based on information provided by the iNaturalist.org (2025) platform, the first observation of *Papilio demoleus* in Mexico was on 15-X-2022 in Tulum, Quintana Roo (<https://inaturalist.org/observations/139651305>). Subsequently, nine more specimens in the state of Quintana Roo in 2024. It is not known how the species arrived in Mexico, but it is most likely that its dispersal was facilitated by a tropical storm or a hurricane.

Hurricane season was particularly active in 2021 and at least one hurricane (Grace) passed through Hispaniola and Jamaica, crossing Yucatán and ending along the coast of Veracruz-Tamaulipas (National Hurricane Center and Central Pacific Hurricane Center, n.d.1). During the 2022 Hurricane season, at least one hurricane (Lisa) passed close to Jamaica and ended in the Gulf of Mexico after crossing Yucatán (National Hurricane Center and Central Pacific Hurricane Center, n.d.2). However, the first specimen photographed and uploaded in iNaturalist.org could have been part of a population established some time before 2021, and arriving to the coast of Mexico from any other island.

On 12-X-2024 a female was detected ovipositing on *Fortunella japonica* (Thunb.) Swingle (Rutaceae), and *Passiflora edulis* Sims (Passifloraceae) plants in Cancun, Quintana Roo (<https://inaturalist.org/observations/139651305>); Evangelina Améndola pers. comm.). In their review, Riaz et al. (2020) do not mention these two species as host of *P. demoleus*. The kumquat appears to be a new host plant record for the species, while passion fruit is the first known host within the family Passifloraceae. Some adults were sighted feeding on flowers of *Tithonia diversifolia* (Hemsl.) A. Gray (Asteraceae) and *Bauhinia divaricata* Lam (Fabaceae) (Carlos Velázquez, Ana Patricia Montero, Shuster Alberto Nah & Evangelina Améndola, pers. comm.). All specimens recorded in Quintana Roo were observed between September and December.

While reviewing all observations of *P. demoleus* in the Americas within iNaturalist.org (2025), it was detected that two specimens were photographed before the first formal continental record of the species by Guerrero et al. (2004). One specimen was observed on 17-IV-1997 in Pococí, Limón, Costa Rica (<https://inaturalist.org/observations/223307439>), corresponding to the first record of *P. demoleus* for Central America, and of course, Costa Rica. Another earlier record for the Americas was posted on 01-IX-2002 in Mao, Valverde, Dominican Republic (<https://inaturalist.org/observations/111800640>).

Among other relevant observations, we noticed that the first record of *P. demoleus* in Panama (<https://inaturalist.org/observations/100187256>) occurred on 03-XI-2021 in David, Chiriquí. After reviewing the observations in the United States, it was noted that there are six records before the one reported by Hayden et al. (2022) in Key West, Florida, being the first on 23-IV-2020 in San Luis Obispo County, California (<https://inaturalist.org/observations/66278726>).

In total, there were 496 observations of this swallowtail within the iNaturalist.org (2025) platform up to 12-I-2025. They were distributed in 16 countries/islands of the Americas (Table 1; Figures 3 and 4). Most observations (84%) occurred in the Dominican Republic (260), Jamaica (76), Puerto Rico (50), and Cuba (32), suggesting that *P. demoleus* populations are already well established on these islands. Other countries had less than 15 records each, Costa Rica and Panama being the only ones with only one record so far (Figures 3A and 4). These 496 observations far exceed the number of previously known sightings of this swallowtail in the Americas, demonstrating the potential of iNaturalist.org to provide information on the geographic distribution of organisms with the invaluable help of Citizen Researchers.

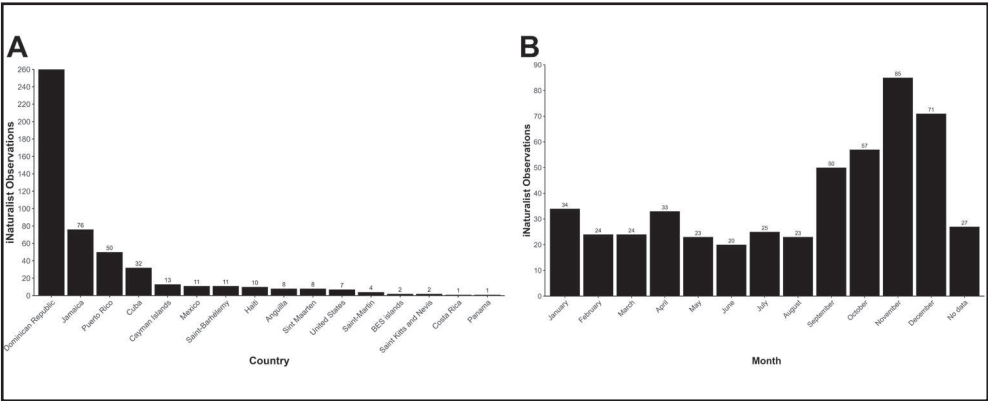
Table 1. Number of observations of *Papilio demoleus* by country and year uploaded in the iNaturalist.org (2025) platform in the Americas.

Country	1997-2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024 / 2025*
Dominican Republic	7	7	3	12	13	19	43	55	34	31	25 / 0
Jamaica	0	2	2	5	1	2	1	6	17	16	20 / 1
Puerto Rico	1	0	1	0	1	0	7	5	8	13	8 / 1

Cuba	0	0	3	4	2	4	6	2	4	1	4 / 0
Cayman Islands	0	0	0	0	1	0	1	0	3	3	4 / 0
México	0	0	0	0	0	0	0	0	2	0	9 / 0
Saint-Barthélemy	0	1	1	0	0	0	0	0	3	2	3 / 1
Haiti	0	0	0	1	0	0	1	0	2	2	0 / 0
Anguilla	0	0	0	1	0	2	0	0	3	1	1 / 0
Sint Maarten	1	1	0	0	0	4	0	0	1	1	0 / 0
United States	0	0	0	0	0	0	3	0	3	1	0 / 0
Saint-Martin	0	0	0	0	0	0	0	2	0	1	0 / 0
BES islands	0	0	0	0	0	0	0	0	0	0	0 / 2
Saint Kitts and Nevis	0	0	0	0	0	0	0	0	0	0	2 / 0
Costa Rica	1	0	0	0	0	0	0	0	0	0	0 / 0
Panamá	0	0	0	0	0	0	0	1	0	0	0 / 0
TOTAL	10	11	10	23	18	31	62	71	80	72	76 / 5

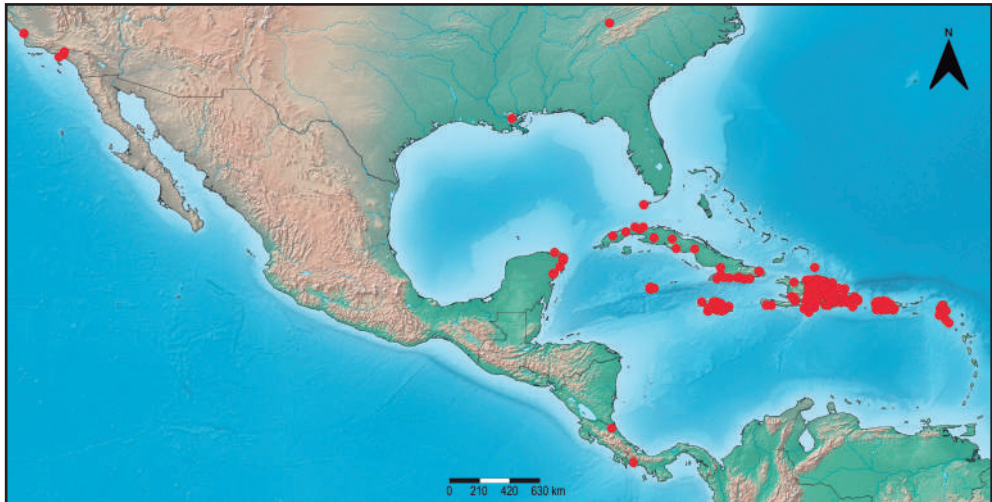
Note: BES islands: Bonaire, Saint Eustatius and Saba. *Information published up to 12-I-2025.

Figure 3. *Papilio demoleus* observations in the Americas, as found in the iNaturalist.org platform (up to January 2025). **A.** Total number of observations by country; **B.** Total number of observations by month.



Since its first formal record in the Americas (Guerrero et al. 2004), *P. demoleus* has expanded rapidly in the Caribbean islands, where it appears to be well established. Between 1997 and 2014 there are only 10 observations for the species in iNaturalist.org (2025). However, from 2015 onwards the number of observations has increased considerably, with a minimum number of annual observations of 10 specimens, and a maximum of 80 in 2022 (Table 1). The species seems to be multivoltine and has been recorded year-round, but with a marked increase in sightings during autumn (iNaturalist.org, 2025) (Figure 3B), aligning with previous research in other parts of the world (Devi et al. 2018; Riaz et al. 2020).

The life cycle of this species has been studied in different host plants, climatic conditions, and in different countries (e.g., Peggie et al. 2022). The complete life cycle lasts between 20 and 38 days, with about 15 days for five larval instars and 11 days in its pupal stage. The morphology and color pattern of larvae during the first four instars is very similar and resembles the excreta of a bird. In these instars, the larva also has small spines along its body. During the fifth instar, the larva turns green and has dark brown bands and dots in both dorsal and lateral views (Mihn et al. 2015; Jahnavi et al. 2018).

Figure 4. Geographic distribution of *Papilio demoleus* in the Americas.

Badawi (1981) and Mihn et al. (2015) found the life cycle of this specie gets shorter as the temperature increases ($>25^{\circ}\text{C}$). Jahn timer et al. (2018) observed very low standard deviations in the duration of the different larval stages. Such a short life cycle allows the species to be multivoltine. Adults have a short life span, and there is no major difference between sexes, even though females might live slightly longer than males (Rao, 2015).

According to CONAGUA (2025), the average monthly temperature in two Quintana Roo's cities where *P. demoleus* were reported in iNaturalist.org (2025), Cancún, and Playa del Carmen, is above 24°C throughout the year. The warmest period of the region is between April and October when the average monthly temperature exceeds 27.3°C and reaches 30.7°C . All known records of the butterfly from Quintana Roo, Mexico (11 observations), were posted between September 8 and December 26. This could be related to favorable environmental conditions as other authors have pointed out but could also be linked to their somehow recent arrival in the country, and a low number of individuals as opposed to native species, among other reasons. Consequently, we have found a low number of sightings reported in iNaturalist.org (2025).

Eleven observations of *P. demoleus* on the coast of Quintana Roo, two years after the first known Mexican record, might indicate that even though it might be incipient, at least a population has been already established in the region. Having citrus trees in homes is customary, undoubtedly favoring the establishment of this butterfly. The information available to date is not enough to assess if the species has spread to other municipalities or states; however, it is necessary to take precautions, since this swallowtail is considered a serious citrus pest in many parts of its range (Heppner, 2006; Segarra-Carmona et al. 2010; Minh et al. 2015; Lewis, 2018).

Mexico is one of the main citrus producers and exporters in the world (Maya-Ambía, 2017; Ruiz-Rodríguez et al. 2017). Citriculture is one of the most relevant agricultural activities in Mexico, generating numerous direct and indirect jobs, and an important source of income in rural areas, benefiting 67,000 families who depend on this activity nationwide (Blanco-Rodríguez et al. 2015; Maya-Ambía, 2017; Ruiz-Rodríguez et al. 2017). During the last decades, Mexico has been the world's largest producer and exporter of limes, being Mexican or Key lime [*Citrus × aurantiifolia* (Christm. & Panz.) Swingle] and Persian lime [*Citrus × latifolia* (Yu. Tanaka ex Yu. Tanaka) Yu. Tanaka] the most popular ones (Mendoza-Tornez et al. 2016).

The presence of *P. demoleus* in citrus plantations in Mexico could significantly affect its citrus industry and generate a large economic impact, since its larvae, mainly in the later stages, cause significant damage in nurseries, young seedlings, and new shoots of adult trees (Jahn timer et al. 2018). Severe infestations cause tree defoliation, generating stunted growth and a significant decrease in fruit production (Rao, 2015; Jahn timer et al. 2018; Riaz et al. 2020).

The present work demonstrates that iNaturalist.org is a powerful tool that can provide significant information, whether ecological, phenological or distributional, about any species. In this case, it could be used

to monitor the expansion of *Papilio demoleus* in Mexico, and other regions, allowing the development of actions and strategies to manage or control the species in citrus plantations.

Acknowledgments

We are indebted to Carlos Velázquez, Ana Patricia Montero, and Shuster Alberto Nah for providing photographs, information, and specimens of *Papilio demoleus* collected in Mexico; to Evangelina Améndola and Elias Siebenborn for sharing photographs of host plants and live adults of *P. demoleus* in Quintana Roo, Mexico.

Conflict of Interest

The authors declare that there is no known financial interest or personal relationship that could have influenced the work presented herein.

References

- Badawi, A. (1981). Studies on some aspects of the biology and ecology of the citrus butterfly *Papilio demoleus* L. in Saudi Arabia (Papilionidae, Lepidoptera). *Zeitschrift für Angewandte*, 91(1-5), 286-292. <https://doi.org/10.1111/j.1439-0418.1981.tb04481.x>
- Başbay, O., John, E., & Salimeh, M. (2020). Preliminary note on the range expansion of *Papilio demoleus* (Lepidoptera: Papilionidae) in south-eastern Turkey, and on the first documented arrival of this invasive species at the Mediterranean coast of Syria. *Phegea*, 48, 20-21.
- Bastardo, R. H. (2012). Nuevas localidades para *Greta diaphanus quisqueya* (Fox, 1963) y *Papilio demoleus* Linnaeus, 1758 (Lepidoptera: Papilionoidea) en la Hispaniola. *Novitates Caribaea*, (5), 103-109. <https://doi.org/10.33800/nc.v0i5.139>
- Benyamini, D., Bruschini, C., Serra, G., & John, E. (2007). First confirmed records of *Papilio demoleus* (Linnaeus 1758) in Syria, with comments on the species' appearance in Turkey and the Dominican Republic. *News of the Israeli Lepidopterists Society*, 24(2), 4-11.
- Bhutani, D. K., & Jotwani, M. G. (1975). Trends in the control of insect pests of fruit crops in India. *Pesticides*, 9(4), 139-149.
- Blanco-Rodríguez, E., Romero-Nápoles, J., Lomeli-Flores, J. R., Mora-Aguilera, G., & Dietrich, C. (2015). Cicadélidos asociados a cítricos en la Península de Yucatán, México. *Entomología Mexicana*, 2, 830-834.
- Collins, N. M., & Morris, M. G. (1985). *Threatened Swallowtail Butterflies of the World: The IUCN Red Data Book*. Gland & Cambridge, IUCN.
- CONAGUA (2019). *Información Estadística Climatológica. Información de Estaciones Climatológicas*. Estaciones (Cancún, Playa del Carmen). <https://smn.conagua.gob.mx/es/climatologia/informacion-climatologica/informacion-estadistica-climatologica>
- De la Maza-Elvira, J., & De la Maza-Elvira, R. G. (2022). *An illustrated atlas of Mexican butterflies: Papilionidae*. Colección de la Maza de Lepidoptera de México.
- De la Maza-Elvira, R. G., & Gutiérrez-Carbonell, D. (1992). Rhopaloceros de Quintana Roo, su distribución, origen y evolución. *Revista de la Sociedad Mexicana de Lepidopterología*, 15(1), 1-43.
- De la Maza-Ramírez, R. F. (1987). *Mariposas Mexicanas: Guía para su colecta y determinación*. Fondo de Cultura Económica, S. A.
- Devi, M., Jaglan, R., Yadav, G., & Singh, N. (2018). Population dynamics of citrus butterfly, *Papilio demoleus* L. (Lepidoptera: Papilionidae) in Kinnow (*Citrus nobilis* × *Citrus deliciosa*) as influenced by abiotic factors. *International Journal of Current Microbiology and Applied Sciences*, 7(2), 475-478. <https://doi.org/10.20546/ijcmas.2018.702.059>
- DeVries, P. J. (1987) *The Butterflies of Costa Rica and their natural history. Papilionidae, Pieridae, Nymphalidae*. Princeton University Press.
- Eastwood, R., Boyce, S. L., & Farrell, B. D. (2006). The Provenance of Old World Swallowtail Butterflies, *Papilio demoleus* (Lepidoptera: Papilionidae), Recently Discovered in the New World". *Annals of the Entomological Society of America*, 99(1), 164-168. [https://doi.org/10.1603/0013-8746\(2006\)099\[0164:tpoows\]2.0.co;2](https://doi.org/10.1603/0013-8746(2006)099[0164:tpoows]2.0.co;2)
- Fernández Hernández, D. M., & Minno, M. C. (2015). The slowly expanding range of *Papilio demoleus* Linnaeus (Lepidoptera: Papilionidae) in Cuba. *Tropical Lepidoptera Research*, 25(1), 8-14.

- Garraway, E., Murphy, C. P., & Allen, G. A. (2009). *Papilio demoleus* (the lime swallowtail) (Lepidoptera: Papilionidae), a potential pest of citrus, expanding its range in the Caribbean. *Tropical Lepidoptera Research*, 19(1), 58-59.
- Guerrero, K. A., Veloz, D., Boyce, S. L., & Farrell, B. D. (2004). First new world documentation of an Old World Citrus Pest, the Lime Swallowtail *Papilio demoleus* (Lepidoptera: Papilionidae), in the Dominican Republic (Hispaniola). *American Entomologist*, 50(4), 227-229. <https://doi.org/10.1093/ae/50.4.227>
- Hayden, J. E., Burnette, K. M., & Moore, M. R. (2015). *Pest alert: Papilio demoleus, Lime Swallowtail, on Key West, Florida. Gainesville (FL, USA)*. Florida Department of Agriculture and Consumer Services, Division of Plant Industry.
- Hernández-Lara, J. L., Vargas-Zaleta, N. E., Enríquez-García, F., Uranga-Valencia, L. P., & Morelos-Suet, P. E. (2022). Principales cítricos cultivados en Veracruz, México. *Revista Biológica Agropecuaria Tuxpan*, 10(2), 212-218. <https://doi.org/10.47808/revistabioagro.v10i2.445>
- Heppner, J. B. (2006). *Lime Swallowtail in the Caribbean and Possible Impacts for Florida Citrus*. Florida Department of Agriculture and Consumer Services, Division of Plant Industry. <https://ccmedia.fdacs.gov/content/download/9794/file/papilio-demoleus.pdf>
- Homziak, N. T., & Homziak, J. (2006). *Papilio demoleus* (Lepidoptera: Papilionidae): A new record for the United States. Commonwealth of Puerto Rico. *Florida Entomologist*, 89(4), 485-488. [https://doi.org/10.1653/0015-4040\(2006\)89\[485:PDLPA N\]2.0.CO;2](https://doi.org/10.1653/0015-4040(2006)89[485:PDLPA N]2.0.CO;2)
- iNaturalist.org (2025) <https://www.inaturalist.org>
- Jahnavi, M., Ramakrishna, R., & Sarada, G. (2018). Biology and morphology of citrus butterfly *Papilio demoleus* Linnaeus (Lepidoptera: Papilionidae) on acid lime. *Journal of Entomology and Zoology Studies*, 6(1), 1556–1561.
- James, D. G., & Lohman, D. J. (2024). *The lives of butterflies. A natural history of our planet's butterfly life*. Princeton, Princeton University Press. <https://doi.org/10.2307/j.ctv303wbwf>
- Lewis, D. S. (2018). *Lime Swallowtail Papilio demoleus Linnaeus (Insecta: Lepidoptera: Papilionidae)*. University of Florida. Department of Entomology and Nematology UF/IFAS, Extension 2018. <https://edis.ifas.ufl.edu/publication/IN786>
- Matsumoto, K. (1996). Establishment of *Papilio demoleus* L. (Papilionidae) in Java. *Journal of the Lepidopterists' Society*, 50, 139-140.
- Matsumoto, K. (2002). *Papilio demoleus* (Papilionidae) in Borneo and Bali. *Journal of the Lepidopterists' Society*, 56, 108-111.
- Maya-Ambía, C. J. (2017). Cítricos mexicanos en el mercado japonés: experiencias y oportunidades para Sinaloa. *México y la Cuenca del Pacífico*, 6(16), 107-142. <https://doi.org/10.32870/mycp.v6i16.523>
- Mendoza-Tornez, R., Marquez-Berber, S. R., Almaguer-Vargas, G., Aguilar-Avila, J., Gardezi, A. K., & Ayala-Garay, A. V. (2016). Value network of the persian lime in Mexico. *AGROFOR International Journal*, 1(3), 39-45. <https://doi.org/10.7251/AGRENG1603039T>
- Mihn, H. G., Giang, H. T. T., & Trang, H. T. Q. (2015). Studies on some aspects of the biology and ecology of citrus butterfly *Papilio demoleus* (Papilionidae: Lepidoptera) on citrus in Vietnam. *Journal of Tropical Asian Entomology*, 4(1), 20-27.
- Moonen, J. J. M. (1991). *Papilio demoleus* L. in Java (Lep.; Papilionidae). *Tyô to Ga*, 42, 93-94.
- Morgun, D. V., & Wiemers, M. (2012). First record of the Lime Swallowtail *Papilio demoleus* Linnaeus, 1758 (Lepidoptera, Papilionidae) in Europe. *Journal of Research on the Lepidoptera*, 45, 85-89. <https://doi.org/10.5962/p.266485>
- National Hurricane Center and Central Pacific Hurricane Center (n.d.1) 2021 Atlantic Hurricane Season. <https://www.nhc.noaa.gov/data/tcr/index.php?season=2021>
- National Hurricane Center and Central Pacific Hurricane Center (n.d.2) 2022 Atlantic Hurricane Season. <https://www.nhc.noaa.gov/data/tcr/index.php?season=2022&basin=atl>
- Nielsen, J. E. (2017). Additional characters for separating adults of *Papilio demoleus sthenelus* W.S. Macleay, 1826 (Lepidoptera: Papilionidae) from *P. demoleus* L. subspecies of biosecurity concern to Australia. *Australian Entomologist*, 44(2), 75-84.
- Nieukerken, E. J. van, Kaila, L., Kitching, I. J., Kristensen, N. P., Lees, D. C., Minet, J. et al. (2011). Order Lepidoptera Linnaeus, 1758. In Z.-Q. Zhang (Ed.). *Animal biodiversity: an outline of higher-level classification and survey of taxonomic richness*. *Zootaxa*, 3148, 212-221. <https://doi.org/10.11646/zootaxa.3148.1.39>
- Núñez-Águila, R. (2007). *Papilio demoleus* Linnaeus, 1758 en Cuba (Lepidoptera: Papilionidae). *Boletín Sociedad Entomológica Aragonesa*, 41, 440.
- Peggie, D., Supadi, S., Guntoro, G., Sarino, S., Fatimah, F., Rachmatiyah, R., & Haeuser, C. (2022). *Papilio demoleus* L. and *Papilio polytes* L. (Lepidoptera: Papilionidae) reared on some host plants at butterfly research facility, Lipi

- Cibinong, West Java, Indonesia. *Treubia*, 49(1), 41-56. <https://doi.org/10.14203/treubia.v49i1.4468>
- R Core Team. (2023). *R: a language and environment for statistical computing*. R Foundation for Statistical Computing.
- Rao, A. R. (2015). Studies on biology and morphometrics of citrus butterfly *Papilio demoleus* (Linnaeus) (Lepidoptera: Papilionidae) on Sathgudi Sweet Orange *Citrus sinensis* Swingle. *International Journal of Current Research in Life Sciences*, 4(3), 168-171.
- Riaz, S., Johnson, J. B., Rasheed, T., & Wiemers, M. (2020). Morphology, life cycle and management of two invasive subspecies of *Papilio demoleus* (Lepidoptera: Papilionidae): A review. *Journal of Applied Entomology*, 144(10), 1-12. <https://doi.org/10.1111/jen.12828>
- Ruiz-Rodríguez, R., Vela-Hernández, G. V., & Moreno-Luce, R. G. (2017). Exportación de cítricos mexicanos, alternativas para el mercado de exportación. *Horizontes de la Contaduría en las Ciencias Sociales*, 3(6), 77-85.
- Segarra-Carmona, A. E., Cabrera-Asencio, I., Flores-López, L. E., & Morales-Collado, L. (2010). Ciclo de vida y control de la mariposa asiática de los cítricos, *Papilio demoleus* (Lepidoptera: Papilionidae), una nueva plaga invasiva en Puerto Rico. *The Journal of Agriculture of the University of Puerto Rico*, 94, 165-174. <https://doi.org/10.46429/jaupr.v94i1-2.2592>
- Shorthouse, D. P. (2010). *SimpleMappr, an online tool to produce publication-quality point maps*. <http://www.simplemappr.net>
- Smith, C. R., & Vane-Wright, R. I. (2008). Classification, nomenclature and identification of lime swallowtail butterflies: A post-cladistic analysis (Lepidoptera: Papilionidae). *Systematics and Biodiversity*, 6(2), 175-203. <https://doi.org/10.1017/S1477200008002703>
- Tyler, H. A., Brown, K. S., & Wilson, K. H. (1994). *Swallowtail butterflies of Americas: a study in biological dynamics, ecological diversity, biosystematics, and conservation*. Gainesville, Scientific Publishers, Inc.
- Wehling, W., Núñez, C., & Glassberg, J. (2006). Lime swallowtails in a new world. *American Butterflies*, 14(2), 30-34.
- Wickham, H. (2016). *ggplot2: elegant graphics for data analysis*. Springer-Verlag. <https://doi.org/10.1007/978-3-319-24277-4>
- Yong, S., Teruel, R., & Breto, D. (2018). Occurrence of the Lime Swallowtail *Papilio demoleus* Linnaeus, 1758(Lepidoptera: Papilionidae) in Western Cuba. *Ecologica Montenegrina*, 18, 15-17. <https://doi.org/10.37828/em.2018.18.2>
- Yu, X.-T., Yang, F.-L., Da, W., Li, Y.-C., Xi, H.-M., Cotton, A. M., Zhang, H.-H., Duan, K., Xu, Z.-B., Gong, Z.-X., Wang, W.-L., & Hu, S.-J. (2023). Species richness of Papilionidae butterflies (Lepidoptera: Papilionoidea) in the Hengduan mountains and its future shifts under climate change. *Insects*, 14(3), 259. <https://doi.org/10.3390/insects14030259> PMID:36975944 PMCID:PMC10058169

José de Jesús García-Díaz
 Instituto de Ecología A. C.
 Red de Biodiversidad y Sistemática
 Carretera antigua a Coatepec 351, El Haya
 91073 Xalapa, Veracruz
 MÉXICO / MEXICO
 E-mail: mexicastnia@hotmail.com
<https://orcid.org/0000-0002-3559-8204>

y / and

*Jorge M. González
 Austin Achieve Public Schools
 5908 Manor, Rd.
 Austin, TX 78723
 EE.UU. / USA
 E-mail: gonzalez.jorge.m@gmail.com
<https://orcid.org/0000-0001-7208-7166>

y /and

Research Associate
McGuire Center for Lepidoptera and Biodiversity
Florida Museum of Natural History
3215 Hull Rd
Gainesville, FL 32611
EE.UU. / USA

*Autor para la correspondencia / *Corresponding author*

(Recibido para publicación / *Received for publication* 14-II-2025)

(Revisado y aceptado / *Revised and accepted* 26-VII-2025)

(Publicado / *Published* 30-VI-2026)

Derechos de autor: El autor(es). Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia de Reconocimiento 4.0 Internacional de Creative Commons (CC BY 4.0) que permite el uso, distribución y reproducción sin restricciones en cualquier medio, siempre que se cite al autor original y la fuente. / **Copyright:** The author(s). This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.