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Natural history of the Guatemalan copper *Iophanus pyrrias* (Godman and Salvin, 1887) (Lepidoptera: Lycaenidae) in Guatemala

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ABSTRACT. Detailed information including photographs about the natural history of *Iophanus pyrrias* (Godman and Salvin 1887) in Guatemala is presented. Information includes geographic and altitudinal distribution and phenology. We reconfirm the immatures stages use *Muehlenbeckia tamnifolia* (Kunth) Meisn., 1841 (Polygonaceae) as the host plant.

Key words: Natural history, distribution, Guatemala, Lycaenidae, Lycaeninae, host plant.

RESUMEN. Se presenta información detallada incluyendo fotografías de la historia natural de *Iophanus pyrrias* (Godman y Salvin 1887) en Guatemala. La información incluye distribución geográfica y altitudinal y fenología. Confirmamos que los estados inmaduros se alimentan de *Muehlenbeckia tamnifolia* (Kunth) Meisn., 1841 (Polygonaceae).

Palabras clave: Historia natural, distribución, Guatemala, Lycaenidae, Lycaeninae, planta hospedera.

INTRODUCTION

The Guatemalan copper is a small butterfly in the family Lycaenidae. This family is well known for their small, usually very colorful species. With an estimated number of over 6,000 species, it comprises around a third of all Papilionoidea butterflies (Pierce et al. 2002). Even though Guatemala has a very high diversity of butterflies in this family (171 species in 69 genera); the subfamily Lycaeninae is represented by only one species, *Iophanus pyrrias* (Godman and Salvin 1887) (Salinas-Gutiérrez et al. 2009). In the American continent this subfamily is mostly restricted to North America and contains 18 species mostly in the United States (Warren et al. 2016). The only species that has a distribution range into the neotropics is the Guatemalan copper, known from Chiapas (Mexico) and Guatemala (Lamas 2004). Specimens from Chiapas are mainly known from the vicinity of San Cristobal de Las Casas (e.g. cerro Huitepec, coll. J. F. Emmel, 12 Aug. 1966); other localities include Motozintla, near Tacaná Volcano and 1.7 km NW of Chamula (GBIF.org 2021). Originally this species was described in the genus *Chrysophanus* Hübner 1818, but this has now been restricted to species in East Asia (Heppner 2007). The biogeographical affinities of this butterfly are mysterious (Yago et al. 2010). *Iophanus pyrrias* appears morphologically and ecologically most similar to species of the New Guinean genus *Melanolycaena* Sibatani (1974); both genera have

been assigned to the primarily Southeast Asian Heliophorini (Ibid). Species of *Melanolycaena*, as well as *I. pyrrias*, share the same larval host plant genus (*Muehlenbeckia*) and occur in relatively high elevation tropical cloud forest habitats (Yago et al. 2010). Nevertheless, recent molecular analysis suggests that *I. pyrrias* has a closer affinity to some North American copper butterflies (Zhang et al. 2020).

The information published about this species since the original description by Godman and Salvin (1879-1901) is scanty. The original description indicates the relatively nonspecific distribution: GUATEMALA, Volcan de Fuego, San Geronimo, Chilasco, Cubulco, Quiche Mountains and Dueñas. Altitudinal information given was “6000-7000 feet” (Godman and Salvin 1887). The only other publications available with information on the Guatemalan copper are Heppner (2007), and Yago et al. (2010). The former reported this species at Fuentes Georginas, Quetzaltenango (alt. 2,400 m); while the latter described the immature stages from a colony at Acatenango, Chimaltenango (alt. 2,200 m), and speculated that the butterfly had multiple annual generations. Observations reported here largely confirm aspects of the biology reported by Yago et al. (ibid) and expand the known range and flight season within Guatemala.

More than 20 years ago, author GRB brought to the attention of the first author the importance of finding more information about this species. Most of the life cycle, distribution, altitudinal range, and host plants were still vague. During dozens of field trips around the country by JM-S, information about this butterfly was recorded, mostly photographically. Dedicated trips to learn more about the life history of this species were undertaken by both authors in March 2015 and May 2016.

The Guatemalan copper was observed many times associated with the presence of *Muehlenbeckia tamnifolia* (Kunth) Meisn., 1841. This plant has a very wide distributional range from Mexico and Central America to Colombia, Ecuador, Perú, Bolivia and Argentina (Tropicos.org 2021). In Guatemala it is a rare plant that occurs in middle to high elevations. In most cases, examining the plants revealed *Iophanus pyrrias* larvae feeding damage and in many cases eggs and caterpillars, which are very hard to see because of their size and appearance. It is also commonplace to find the butterflies flying around and landing on or very close to the host plant.

MATERIALS AND METHODS

Materials. The natural history and distribution records are based on specimens documented and collected in Guatemala. Pinned specimens and larval stages samples were deposited at the Universidad del Valle de Guatemala Collection of Arthropods (UVGC) and University of California, Riverside Entomology Museum (UCR). An herbarium sample of *M. tamnifolia* was deposited at the Universidad del Valle de Guatemala Herbarium (UVAL00021837). Caterpillars were preserved in 95% ethanol. Field photography was done with a Nikon D7100 camera with a Micro-Nikkor 105 f/2.8 lens and a Canon SL1 with 100 mm f/2.8L and 65mm macro lenses.

Field study. Since the first communication between both authors of this publication in the late 1990s, the first author has been working on finding more information about the Guatemalan copper. During many trips several populations were found and eventually it was discovered that the butterfly was associated with a large climbing vine in the family Polygonaceae. The growth habit of this plant is peculiar and easy to distinguish while driving around. Subsequent documentation of the species occurrence was facilitated by observing the host plant while driving through suitable habitat.

Study area. Information provided for distribution was gathered through the mountains of Guatemala. The first author travels frequently through the country and was able to document different popula-

tions of the Guatemalan copper. The country has an area of 108,889 square kilometers of which about half is covered with mountains. There are several mountain ranges and volcanoes, with a maximum altitude of 4,220 m above sea level at Tajumulco Volcano.

Host plant. The plant associated with the Guatemalan copper was identified by Carlos R. Beutelspacher as *Muehlenbeckia tamnifolia* (Kunth) Meisn., 1841, thus confirming its reported use by Yago, et al. (2010). The plant is not common but usually obvious with its lush and conspicuous growth (Fig. 1). The flowers are greenish white and very small (Fig. 2); fruits abundant, small, and red (Fig. 3); leaves alternate and lanceolate (Fig. 4). The plants' new growth is very distinctive with its reddish brown and green leaves and reddish erect stems (Fig. 4).



Figures 1-2. Habitus of *Muehlenbeckia tamnifolia*. **Fig. 1.** Dipterologist Gary Steck walking by a big patch of *M. tamnifolia* in cerro Piñalón, sierra de Las Minas, May 2010. **Fig. 2.** Flower of *M. tamnifolia* from cerro Tecpán, 3066 m altitude, October 2020.

Under laboratory conditions, *I. pyrrhias* larvae can feed on *Rumex crispus* L. (Polygonaceae), a plant of Eurasian origin that has spread throughout the world. Ultimately the larvae fail to mature on this plant (GRB, personal observation). It is worth noting that several Lycaeninae species in Eurasia, North America, and Africa use various species of *Rumex* as a larval host plant. As reported by Yago, et al. (2010), there are two native *Rumex* species in Guatemala, neither of which are reported to be associated with *I. pyrrhias*. Miller and Brown (1979) quote the larval host plant as *Rumex* via personal communication with J. F. Emmel. There are no botanical specimens associated with this second-hand claim, and the description of the host by Emmel, as related by GRB, comports more with the description of *Muehlenbeckia*; the claim of *Rumex* as a host remains unsubstantiated.

RESULTS AND DISCUSSION

Geographic distribution. Populations of *I. pyrrhias* were found in seven Guatemalan departments: Chimaltenango, El Progreso, Guatemala, Quetzaltenango, Quiché, Sacatepéquez, and San Marcos (Fig. 5). All these departments have high altitude mountains above 1,800 m. Interestingly, the host plant spe-



Figures 3-4. Habitus of *Muehlenbeckia tamnifolia*. **Fig. 3.** Fruits of *M. tamnifolia* from cerro Tecpán, 3066 m altitude, October 2020. **Fig. 4.** Leaves and new growth of *M. tamnifolia* from sierra de Las Minas, 2568 m altitude, May 2010 showing leaf shape and conspicuous growth.

cies is reported to occur as far south as Argentina (Tropicos.org 2021), whereas the Guatemalan copper is known only from Guatemala and adjacent mountainous regions of Mexico.

Altitudinal distribution. Populations were found at altitudes that range from 1,800 meters at the Refugio del Quetzal, San Marcos, to 3,066 m at cerro Tecpán, Chimaltenango. Most populations were found at an average of 2,502 meters (Table 1).

Phenology. Adults of *I. pyrrhias* were found during the months of March, May, June, July, September, October, and November. In Chicabal volcano (Fig. 6) adults are common in the northwestern shores of the lagoon in late November.

Ecology. The distribution of *I. pyrrhias* in Guatemala is restricted to three specific life zones (*sensu* Holdridge). Most sites where the butterfly was found occur in tropical montane wet forest (TM-wf), characterized by high elevation (2,445-3,066 m) and high precipitations (average 1,484 mm of yearly rain) (Pérez-Irugaray et al. 2018). The second ecological zone where the Guatemalan copper is most abundant is in tropical lower montane moist forest (TLM-mf), characterized by high elevation precipitation (average 1,360 mm of yearly rain) (Pérez-Irugaray et al. 2018). *I. pyrrhias* was also found in tropical lower montane forest (TLM-mf), characterized by being lower in elevation than the others (2,200-2,635 m) and with higher average yearly precipitation (2,401 mm) (Pérez-Irugaray et al. 2018). The copper is much less abundant in this life zone, requiring inspection of several plants to find caterpillar damage and adults flying.

Adults. They can be typically found along roadsides and forest openings (often adjacent to agricultural plots), in association with its host plant. Seasonal diapause has not been observed and adults may

be active during all months of the year. Adult wingspan: forewing length from base to apex 12.25 mm and 12.38 mm, respectively, for males and females; hindwing length from base to tornus 10.75 mm for both sexes (N=4); tail length 1.625 mm for males (N=4) and 2.17 mm for females (N=3). *Male*. Dorsal coloration dark brown with iridescent purple. Hind wings with premarginal orange undulated line bordered by very dark brown and thin purplish-blue line; tails short and orange (Fig. 7). Ventral coloration lighter brown, front wing with large yellowish area and three longitudinal dark lines (middle one short); two premarginal thin dark lines. Hind wing homogeneous light brown with two lines of wide darker reddish marks and a third line with separated marks seemingly spotted. Two premarginal lines, one very thick and dark and one thin closer to the margin; area between lines and tails brick red in color (Fig. 8). *Female*. Dorsal coloration similar to male except iridescent purple much reduced, and front wing with large yellowish orange postdiscal suffusion and three longitudinal dark lines (middle one short). Posterior wing light brown with two dark lines; orange premarginal undulated line thick (Fig. 9). Ventral coloration similar to male (Fig. 10).

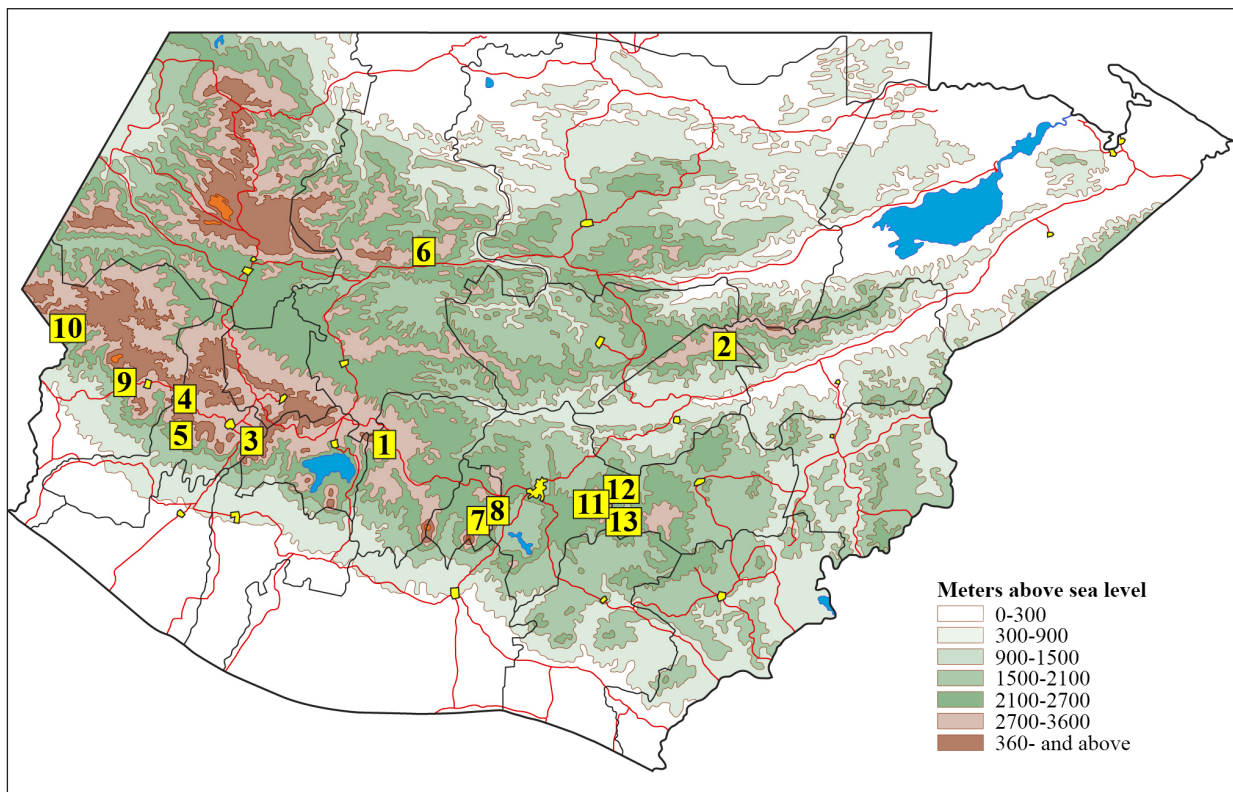


Figure 5. Map of central Guatemala showing known distribution for *Iophanus pyrrias*: **1.** Cerro Tecpán (Chimaltenango); **2.** Cerro Piñalón (El Progreso); **3.** Fuentes Georginas (Quetzaltenango); **4.** San Juan Ostuncalco (Quetzaltenango); **5.** Volcán Chicabal (Quetzaltenango); **6.** Laj Chimel (Quiché); **7.** Finca El Pilar (Sacatepequéz); **8.** Finca El Pilar (higher elevation); **9.** Refugio del Quetzal (San Marcos); **10.** Vega del Volcán (San Marcos); **11.** Cerro antenas Las Nubes (Guatemala); **12.** Finca San Francisco Las Nubes; and **13.** El Naranjo, Las Nubes (Guatemala).

Immature stages. Female *I. pyrrias* deposit eggs singly on host plant leaves (Fig. 11). The tiny neonatal larvae hatch within a week, feed on the leaves and are yellowish (Fig. 12). They grow quickly and molt four times before pupating on the host plant. Larvae are pale green (Fig. 13-14), often with maroon dorsal line (with pale whitish border). Pupae are initially translucent green and darken to a mottled brown and have a compact, rounded shape typical of many lycaenid butterflies (Fig. 15). The pupae are attached to a silken pad on foliage by cremastral hooks on the venter of the posterior segments and a slender silk girdle around the thorax. Adults mature and eclose in 1-2 weeks, depending on ambient temperature.

Table 1. Geographic information of populations of *Iophanus pyrrias* in Guatemala.

Locality	Department	Altitude (m)	Coordinates
1-Cerro Tecpán	Chimaltenango	3,066	14.782270 -91.022993
2-Cerro Piñalón	El Progreso	2,568	15.084070 -89.942770
3-Fuentes Georginas	Quetzaltenango	2,445	14.750303 -91.480302
4-San Juan Ostuncalco	Quetzaltenango	3,000	14.910576 -91.668968
5-Volcán Chicabal	Quetzaltenango	2,746	14.788959 -91.658524
6-Laj Chimele	Quiché	2,200	15.446116 -90.805689
7-Finca El Pilar	Sacatepéquez	2,635	14.5185318 -90.6912460
8-Finca El Pilar	Sacatepéquez	2,260	14.53071 -90.69018
9-Refugio del Quetzal	San Marcos	1,800	14.938221 -91.874380
10-Vega del Volcán	San Marcos	2,590	15.1582203 -92.0836487
11-Cerro antenas Las Nubes	Guatemala	2,500	14.556871 -90.318833
12-Finca San Francisco Las Nubes	Guatemala	2,367	14.553755 -90.322500
13-El Naranjo Las Nubes	Guatemala	2,351	14.555576 -90.335417



Figures 6. Aerial photo of Chicabal Volcano and its lagoon, typical habitat for *I. pyrrias*. Visible in the back Santa María (the tallest) and Zunil (to the right) volcanoes, where other populations are known near Fuentes Georginas.



Figures 7-15. Adult *Iophanus pyrrhias* and immatures stages. **7.** Male dorsal aspect from cerro Tecpán, 3044 m altitude, September 2015. **8.** Male lateral aspect from finca El Pilar, 2260 m altitude, November 2007. **9.** Female dorsal aspect from San Juan Ostuncalco, 3000 m altitude, March 2015. **10.** Female ventral aspect from cerro Piñalon, 2568 m altitude, May 2010. **11.** Egg. **12.** First instar larva. **13.** Second instar larva. **14.** Fourth instar larva. **15.** Pupa.

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