Biology of the introduced species *Triatoma lecticularia* (Hemiptera: Reduviidae) to northwestern Mexico, under laboratory conditions


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**A B S T R A C T**

The first record of *Triatoma lecticularia* out of its reported distribution area together with the brief description of the said area is provided in this paper. In addition, some biological parameters related to hatching of eggs, life cycle and feeding and defecation behaviors for each instar of one population of *T. lecticularia* from its previously reported distribution area (PR) and for each instar of that introduced recently found population (IS) of this species were evaluated and compared. Twenty-eight specimens were collected from IS, mostly (64.29%) from reported distribution area (PR) and for each instar of that introduced recently found population (IS) of this species were evaluated and compared. Twenty-eight specimens were collected from IS, mostly (64.29%) from peridomestic areas (mainly chicken coops). No significant (*p > 0.05*) differences were recorded between the two studied cohorts in their average time to hatch, which was close to 19 days. The median egg-to-adult development time, the number of blood meals at each nymphal, the instar mortality rates and median time-lapse for beginning of feeding were significantly (*p < 0.05*) shorter for the IS cohort. Median feeding time was higher in PR. Defecation delay was shorter than 10 min in both studied cohorts. Given these results, the introduced recently found population of *T. lecticularia* could be considered an important potential vector of *Trypanosoma cruzi* to human populations and could replace main triatominie species on its new distribution area.

**1. Introduction**

Chagas disease is present in 21 American countries, where there are estimated between seven and eight million people infected, 65 million people at risk of being infected and about 28,000 cases of newly infected people each year (Crompton, 2013). In the absence of vaccines and effective treatments, the main strategy for controlling Chagas disease is based on vector transmission prevention (Crompton, 2013). However, only domestic triatominie species are susceptible of control since habitats of synanthropic and sylvatic species are out of reach. The importance of synanthropic and sylvatic triatominie species, which are frequently considered as “secondary vectors”, is given by two phenomena: those species that maintain the sylvatic cycle of *Trypanosoma cruzi*, infecting or re-infesting wild reservoirs, which mean a permanent risk of transmission of *T. cruzi* to human when those wild animals get in contact with human populations (Silveira, 2014). Also, it has been recorded on different areas that those secondary species replace primary vectors in keeping the domestic cycles of *T. cruzi* when they have been eliminated by controlling measures, as recorded in different countries. *Triatoma infestans* (a primary vector) has been substituted by different species on different countries: by *Pantronygus megistus*, *T. sordida*, *T. brasiliensis* and *T. pseudomaculata*, on different areas of Brazil; by *T. guasayana*, *T. platensis*, *T. sordida* and *T. paragonica* on different areas of Argentina, whereas in Uruguay, *T. infestans* has been substituted by *T. rubrovaria*. In Peru and Ecuador, *Rhodnius ecuadoriensis* (a primary vector) has been substituted by *T. carrioni* and *P. chinai* (Abad-Franch, 2014). One of those secondary vectors is *T. lecticularia*. This species has been collected infected by *T. cruzi* inside peridomestic areas of human dwellings as well as in the nests of the woodrat *Neotoma microps* in the American state of Texas and in the neighboring Mexican state of Nuevo Leon. *Triatoma lecticularia* has been also reported from the south central United States of America east to the Atlantic coast, without any specific description of collection areas (Bern et al., 2011; Martínez-Ibarra et al., 1992; Ramsey et al., 2015).

According to most of the previously studied biological parameters (e.g. life cycle, mortality and feeding and defecation behaviors) under
laboratory conditions, Mexican *T. lecticularia* can be considered as an effective vector of *T. cruzi* to human populations (Martínez-Ibarrá et al., 2007). In Mexico, this triatomine species has only been collected in the northeastern state of Nuevo Leon (with 1.9% prevalence of *T. cruzi* infection in humans). In many Mexican states, local sanitary authorities have a permanent surveillance program for triatomines. Technical and scientific personnel are frequently carrying out surveillances for triatomines in those localities identified as infested by triatomines. They also have a reactive program of two phases: firstly, they give oral and written information about triatomines and their sanitary importance to human inhabitants of areas where environmental conditions are favorable for the presence of triatomines, asking also for collection of them. When the sanitary personnel have received a collected triatomine from inhabitants, they search for more triatomines, sometimes finding unexpected species on a specific area. An example is the surveillance activities by Mexican medical entomologists in the Mexican northwestern state of Sinaloa (where a prevalence of 5.6% infected people by *T. cruzi* has been reported; Carabarín-Lima et al., 2013), have detected the presence of a population of *T. lecticularia*, outside of its normal distribution. It has been previously published that populations of some triatomine subspecies (former species) such as *Meccus phyllosomus picturatus* (= *Meccus picturatus*) and *M. p. mazzotti* (= *M. mazzotti*) from places with different environmental characteristics have shown noticeable differences on some studied biological parameters (Martínez-Ibarrá et al., 2014; Martínez-Ibarrá et al., 2015a), and as a consequence, different capacity of transmitting *T. cruzi* to hosts, included human. Taking into account all those considerations, this current study reports the first collection of *T. lecticularia* in the Pacific Coast of Mexico and briefly describes its habitats on that area and compares some of its biological parameters with the population of *T. lecticularia* from Nuevo Leon, in order to estimate its capacity of transmitting *T. cruzi* to inhabitants of that invaded area.

2. Material and methods

2.1. First discover of introduced *Triatoma lecticularia* population

In November 2014, as a part of their “reactive” surveillance of triatomines, sanitary personnel from the state of Sinaloa, where *M. p. longipennis* and *T. rubida* are the main vectors (Ramsey et al., 2015), received five adult specimens of a small and uncommon (on that area), triatomine species from the locality of Otatillos (25°21′N and 107°24′W), in the municipality of Badiraguato. Since *M. p. longipennis* has been the only triatomine species recently (last five years) and scarcely recorded in Otatillos and in neighboring areas (Valle-Castro 2016, Pers. Com.) sanitary personnel from the state of Sinaloa could not identify those uncommon specimens. As a consequence, they asked for support on identifying those specimens to the Medical Entomologists team of the Laboratorio de Entomología Médica, at the Centro Universitario del Sur, of the Universidad de Guadalajara, who identified the specimens according to the taxonomic key of Lent and Wygodzinsky (1979). All examined specimens showed the typical morphological characteristics of *T. lecticularia* (including their distinctly pilosity, with strong, black, decumbent setae conspicuous on head, pronotum and corium). As a consequence, there was not a chance to confuse those specimens with *T. indica* (which has some morphological resemblance to *T. lecticularia* and is also distributed in the state of Sinaloa) (Lent and Wygodzinsky, 1979).

2.2. Collection of biological material

After that discover, two Medical Entomologists of the Universidad de Guadalajara, partnered with the sanitary personnel of the state of Sinaloa traveled 12 times to Otatillos, two days a month, along spring and summer time in northern hemisphere (April to September) of 2015 to search for specimens of *T. lecticularia*. There were selected those two human dwellings where specimens of *T. lecticularia* have been previously reported from and those 12 on each of the two neighborhoods. On each selected human dwelling, intradomiciliary and peridomiciliary areas as well as natural ecotopes were searched. Sampling embraced all natural ecotopes of triatomines (e.g. bird nests, hollow trees and cracks, holes in the ground, railings, rock pile boundary walls, heaps of stones and hollows in caves). The presence or absence of triatomines in each residence was assessed by performing a 20-min intradomicile and 20-min peridomicile timed manual collection for adult or nymphal triatomines. Daytime searches were conducted by spraying an irritant insecticide using a flashlight to look into cracks and crevices throughout the interior of buildings, in cupboards, behind pictures on walls, and under furniture and bedding. A team of three trained personnel conducted the searches on every single house in each village. The intradomiciliary (domestic) area comprised the interior of houses and attached buildings, including all rooms circumscribed by the main walls of the dwelling in which inhabitants normally sleep. The peridomiciliary (peri-domestic) area was defined as the area surrounding the homestead, which was usually enclosed by a fence and often includes features such as rocks, mounds of construction materials, animal shelters, and agricultural products. Consequently, human dwellings (intradomiciliary and peridomiciliary areas) included the areas from main building of dwelling to fences (from 20 to 30 m) (Cohen et al., 2006), whereas those sites beyond fences were considered as sylvatic habitats. In addition, 30 wire-netting bait-traps were used, based on those described as Noireau traps (Noireau et al., 2002), with each containing a Wistar rat. Traps were placed per night in 15 sylvatic and 15 peridomestic sites, including bug natural ecotopes (described above). Triatominae were collected by hand during the day, with the aid of flashlights, and they were placed inside plastic containers labeled with collection data (place of capture and sex) with tweezers. Daily temperature and humidity data of Otatillos were recovered from those recorded by the Comisión Nacional del Agua in a weather monitoring station in a neighboring locality.

Individuals were collected live and transported to the laboratory, fed on hens and placed individually in Petri dishes until defecation. Infection by *T. cruzi* was determined through microscopic examination of feces. Parasites detected in the feces were collected and intraperitoneally inoculated in Swiss mice.

2.3. Colonies of *Triatoma lecticularia*

After the collection of specimens of *T. lecticularia* from Otatillos, a colony was established. Biological parameters of the second generation of that colony were obtained and compared to those from also the second generation of a laboratory colony of *T. lecticularia* established also in 2014 from at least 30 specimens collected from La Escondida, in the municipality of Linares, Nuevo Leon, inside its normal distribution (Ramsey et al., 2015). Those localities have different environmental characteristics and are geographically far (≈ 1000 km) one to each other (Fig. 1). La Escondida (24°56′N and 99°21′W) is located 350 m asl, has a steppe dry climate (BSI) and has a mean annual temperature of 22 °C. It is characterized by the presence of mesquite (*Prosopis velutina*), acacia (*Acacia farnesiana*) and blackbrush acacia (*A. rigidula*) bushes. Otatillos is situated 240 m asl, has a semi-wet hot climate with humid summer season (Aw) and has a mean annual temperature of 24.5 °C. It is characterized by the presence of pine (*Pinus spp*.), holm oak, oak (*Quercus spp*.), and fir (*Abies religiosa*) forest (Enciclopedia de los y municipios de México, 2017).

Although laboratory rearing imposes a certain degree of selection pressure on aspects of triatomine biology, studied colonies were exposed to standardized environmental conditions that were favorable to triatomine survival. Hence, it was assumed that estimates of biological parameters derived from data collected from the colonized wild populations represent a maximum expression of their biological parameters and are likely to reflect true differences between geographically