

Revision of the Arizona *Rhyssomatus* Schoenherr 1837 (Curculionidae: Molytinae:
Cleogonini)

by

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A Thesis Presented in Partial Fulfillment
of the Requirements for the Degree
Master of Science

Approved March 2023 by the
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ARIZONA STATE UNIVERSITY
May 2023

ABSTRACT

The diverse weevil genus *Rhyssomatus* Schoenherr, 1837 (Curculionidae: Molytinae: Cleoginini) is currently composed of 175 species throughout the New World (O'Brien et. al 1982; Wibmer et. al 1986). The majority of species are generalist feeders and the group contains many notorious agricultural pests, such as *Rhyssomatus nigerimus* Fahraeus 1837 and *R. subtilis* Fiedler 1937 that cause thousands of dollars' worth of crop damage in South America, Central America, and West Indies (Cazado, 2016; Lopez-Guillen, et. al). Although most notable as a crop pest in the literature, the species *Rhyssomatus maginatus* Fahraeus has also proven to be a great success in an Integrated Pest Management (IPM), controlling the invasive leguminous tree *Sesbenia punicea* (Cav.) Benth., in South Africa. (Hoffman & Moran 1991; 1992; 1998; 1999).

The last century has seen revisions of the Neotropical species with Central American species revised in 1904 by Champion and the South American taxa treated by Fiedler in the subsequent years of 1937 and 1942 (O'Brien & Wibmer, 1982; Wibmer & O'Brien, 1986). However, North American fauna have not been treated since Casey in 1895 and revision is needed as climate change and global trade have more than likely expanded the distributional range of previously lower latitude *Rhyssomatus* species northwards.

DEDICATION

To my loving, supportive family; thank you for your patience, encouragement, and understanding from so far away. These years would have been impossible without you.

And to my future husband, Armando Casillas, thank you for being there for me in my darkest hours of sickness and always supporting my love of beetles.

ACKNOWLEDGEMENTS

I would like to express my extreme gratitude to my advisor, Dr. Nico Franz, for always being there for me, especially in the end when I fell ill. I cannot express how much your support and understanding he lended in helping me to finish this degree. And thank you to my wonderful lab for always being open to talking about beetles with me.

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CHAPTER 1: REVIEW OF *RHYSSOMATUS* – SYSTEMATICS AND NATURAL HISTORY

The diverse weevil genus *Rhyssomatus* Schoenherr, 1837 (Curculionidae: Molytinae: Cleoginini) is currently composed of 175 species distributed throughout the New World (O'Brien et. al 1982; Wibmer et. al 1986). The majority of species are generalist feeders, and the group contains many impactful agricultural pests, such as *Rhyssomatus nigerimus* Fahraeus 1837 and *R. subtilis* Fiedler 1937 that cause over 600,000 ha of crop damage in South America, Central America, and Greater Antilles (Cazado, 2016; Lopez-Guillen, et al., 2012). The last century has seen revisions of the Neotropical species with Central American species revised in 1904 by Champion and the South American taxa treated by Fiedler in the subsequent years of 1937 and 1942 (O'Brien & Wibmer, 1982; Wibmer & O'Brien, 1986). However, the North American fauna has not been treated since Casey in 1895 and the Greater Antilles have never been fully studied. Therefore, the monophyly, internal phylogeny, species-level diversity, and reliable, updated species identification resources for this widespread weevil's lineage remain underexplored or unavailable.

Due to the generalist feeding, ovipositing tendencies, and extensive plant association it is no surprise that members of the genus are of considerable agricultural and economic significance. It is likely that the proximity to Mexico, where *Rhyssomatus nigerrimus* Fahraeus 1837 is firmly established, and increased demand for soybean (*Glycine max* (L.) Merrill; a known host of *R. nigerrimus* Fahraeus 1837 and *R. subtilis* (Fiedler 1937c) products within the United States will lead to establishments in the

future. An up-to-date diagnostic key and phylogenetic revision is needed in order to correctly identify these potential pest species.

I will be creating a diagnostic key and species redescrptions to the 12 species of *Rhyssomatus* known to occur in the state of Arizona, U.S. For these species, there are provided habitus images, images of female and male genitalia, and distribution maps based on digitized and georeferenced, online occurrence records published through the SCAN portal. To advance this challenging project, range expansions of species occurring in the United States, Canada, Mexico, and the Greater Antilles based upon loaned specimens from museums around the world (museums are listed in Methods: Sampling).

BACKGROUND

TAXONOMIC AND NOMENCLATURAL HISTORY OF *RHYSSOMATUS*

Dejean previously coined the name *Pyssematus*, Dejean 1835-297 in his checklist “*Catalogue des Coleopteres de la collection de M. Le Comte Dejean, vol.4*” the genus included the species: *P. atratus*, *P. brunnipennis*, *P. carbonarius*, *P. cribricollis*, *P. comptus*, *P. exiguss*, *P. indutus*, *P. lugeus*, *P. mendicus*, *P. mortmorum*, *P. pauperculus*, *P. plebejus*, and *P. rugicollis* (Dejean, 1835). The subsequent year (1836) in his “*Catalogue des Coleopteres de la collection de M. Le Comte Dejean, vol. 5*” Dejean recognized *Pyssematus* as his own lapsus, and renamed it as *Ryssematus* 1837-322; *Ryssematus* included all the species within *Pyssematus*, in addition to *R. anthracinus* and *R. brunneus* (Dejean, 1837). Much later (Bousquet & Bouchard, 2013) the Dejean (1837)

publication date was revised to an earlier one (June 1836), because no dates were included in the published works themselves.

Schoenherr (1837) accepted and validated the name *Rhyssomatus* in a redescription of the genus *Ryssematus* Chevrolat, Dejean 1837-322 (Dejean, 1837; Schoenherr, 1837a). *Orobitis novalis* Germar 1824-245 was newly designated as the type and renamed *Rhyssomatus novalis* (Germar, 1824; Schoenherr, 1837a). Both Dejean 1835:37 and Schoenherr 1837 acknowledged Louis Alexandre Auguste Chevrolat as the author of the names *Ryssematus* 1837 and *Rhyssomatus* 1837 due to the fact that the specimens examined belonged to Chevrolat's personal collection;, as explained in the corresponding segments of Dejean (1837: 322) and Schoenherr (1837a: 364).

Subsequently, Agassiz (1846: 328) emended *Ryssematus* Dejean (1837:322) to *Rhyssomatus* , invoking the Principle of Priority This is because Agassiz, like Dejean (1837:322), adhered to the Principle of Priority. However, Aggassiz's (1846: 328) emendation, along with both of Dejean's (1837: 322) *Ryssematus* and *Rhyssomatus* names, are considered nomeina nuda due The Strickland Code (1842).

In a North American revision, Thomas Lincoln Casey Jr. (1895), using the nomen nudum *Ryssematus* Dejean 1837-322, created a key to the therein 10 recognized North American species of the genus, of which four were newly described and named in Casey (1895): *R. aequalis* Horn 1873, *R. annectens* Casey 1895, *R. grandicollis* Casey 1895, *R.*

lineaticollis Say 1824, *R. medialis* Casey 1895., *R. ovalis* Casey 1892, *R. palmarcollis* Say 1831, *R. parvulus* Casey 1895, *R. pruinus* Boh., and *R. pubescens* Horn 1873. Within the same paper he proposed the new subgenus *Sermysatus*; on the basis of the alternate intervals of the elytra being either carinate or not (Casey, 1895).

Champion (1904) revised the Central American species in his *Biologia Centrali-Americana, Insecta Coleoptera Vol. IV. Part 4, Rhynchophora, Curculionidae*. He provides a diagnostic key that contains 20 new species described by him (*R. acutecostatus*, *R. alternans*, *R. biseriatus*, *R. crenatus*, *R. debilis*, *R. dilaticollis*, *R. laticollis*, *R. latipennis*, *R. latus*, *R. nitidus*, *R. parvulus*, *R. punctato-sulcatus*, *R. puncticollis*, *R. rufescens*, *R. rugosus*, *R. rugulipennis*, *R. sculpturatus*, *R. sculticollis*, *R. subrufus*, *R. yucatanus*) as well as seven previously existing species (*R. morio* Rosenchoeld 1837, *R. nigerrimus* Fahraeus 1837, *R. ovalis* (Casey 1829), *R. pruinus* (Boheman 1845), *R. rufus* Fahraeus 1837, *R. subcostatus* Fahraeus 1837, *R. viridipes* Fahraeus 1837).

Fiedler treated the South American taxa in the subsequent years of 1937 and 1942 (Fiedler, 1937d, 1937a, 1937b, 1937c, 1939b, 1939a, 1939c). The last work conducted on *Rhyssomatus* was conducted by Kuschel in 1955 when he synonymized the monotypic genus of *Polydus* Pascoe 1872 (*Polydus dumosus* (Kuschel, 1955)).



FIGURES 1-6: Dorsal, lateral and frontal habitus images of *Rhyssomatus* species occurring in Arizona. Scale bar= 2mm for dorsal (a) and lateral (b) images; scale bar = 1mm for frontal (c) images.

7. *R. acutecostatus* [ARTSYS0008403]
8. *R. aequalis* [ASUCOB0008404]
9. *R. arizonicus* [ASUCOB0008406]
10. *R. lineaticollis* [ASUHIC0127576]
11. *R. medialis* [ASUCOB0008408]
12. *R. oculatus* [ASUCOB0008409]



FIGURES 7-13: Dorsal, lateral and frontal habitus images of *Rhyssomatus* species occurring in Arizona. Scale bar= 2mm for dorsal (a) and lateral (b) images; scale bar = 1mm for frontal (c) images.

- 13. *R. ovalis* [ASUCOB0008410]
- 14. *R. palmacollis* [ASUHIC0127577]
- 15. *R. parvulus* [ASUCOB0008703]
- 16. *R. pruinosis* [ASUHIC0137719]
- 17. *R. pubescens* [ASUCOB0008768]
- 18. *R. rugulipennis* [ASUCOB0008786]

NATURAL HISTORY

The following natural history account is a broad overview of the ecology and life history of the genus. The sequence of subsections is structured as follows: reproduction, oviposition and egg stage; larval stage; pupal stage.

REPRODUCTION, OVIPOSITION AND EGG STAGE

Prior to oviposition, copulation amongst female and male *Rhyssomatus* within each delineated species usually occurs from June to August on their appropriate host plants. Male *Rhyssomatus* do not participate in any portion of reproduction after copulation (Webster, 1889; Weiss & Dickerson, 1921). Once insemination is completed, the female will either immediately begin oviposition behavior or, if necessary, leave to find an appropriate host. The most commonly documented host of *Rhyssomatus* are milkweed, *Asclepias* (L.). However, they are known generalists and some species pose as a major threat to agricultural crops. Section ‘Host Plant Association’ describes the overall host trends within the genus.

The exact position of the ovipositioning site, if known, varies among species. They have been documented in the stem, apical nodes, on pods/seeds, or on exposed parts of tubers (King & Saunders, 1984; Manee, 1923; Osborn, 1910; Pierce, 1916; Webster, 1889).

The behavior associated with ovipositioning within *Rhyssomatus* is similar among

species. Females use the mandibles at the end of their elongated rostrum to excavate a small cavity in the plant material. This process has been documented to last from 15 minutes to approximately an hour. Females may sometimes create multiple cavities without laying. It is unknown whether this behavior is intentional to confuse predators/parasitoids or dependent on host plant composition. The female then deposits anywhere from one to twenty eggs depending on species and health of the individual (Weiss & Dickerson, 1921). The scar left behind from the ovipositioning process is usually covered in a white-yellowish tint, formed from dried plant sap; the eggs themselves are usually also a whitish-yellow. Known egg sizes vary from 0.5-0.89mm (Weiss & Dickerson, 1921).

Fordyce & Malcolm (2000) conducted an interesting study focusing on *Rhyssomatus lineaticollis* Say, 1824 to determine whether females strategically placed eggs within pith tissue of their host *Asclepias syriaca* L. (milkweed) to avoid the cardenolide defenses of the plant. Results from the study confirmed their hypothesis to be incorrect, as the pith was found to contain higher levels of cardenolides than leaf tissue. However, it was hypothesized that pith ovipositioning permits the emerged larvae to avoid the prolific latex produced by the plant, as the pith does not contain the laticifer system.

LARVAL STAGE

Rhyssomatus larvae are “creamy-white” with a darker, umber head capsule in

literature. The body is cylindrical and tapers at the anterior and posterior ends. Size varies depending on the species and instar and can range from 6-15 mm in length and approximately 1-3 mm wide (Fordyce & Malcolm, 2000; King & Saunders, 1984; Webster, 1889). As with other curculionoids, the larvae have heads that are much smaller than the first segment and they have short to long setae (depending on the species) distributed over the body (Fordyce & Malcolm, 2000; Webster, 1889).

PUPAL STAGE

The pupae of *Rhyssomatus* range in size from 2-7mm (Weiss & Dickerson, 1921). Life history documentation is based primarily on *Rhyssomatus lineaticollis*, *R. annectans*, *R. marginatus*, *R. nigerrimus*, and *R. subcostatus* due to their wide distribution (*R. lineaticollis* and *R. annectans*), biocontrol capabilities (*R. marginatus*), and agricultural pest associations (*R. nigerrimus* and *R. subcostatus*). Based on these species, prepupae emerge from within where the larvae have been feeding (as stated in ‘Natural History: Larva’ the exact locality of the feeding location is variable based on species) in autumn and drop to the sediment where they burrow down ~5-30mm in a meandering style (Fordyce & Malcolm, 2000; Strathie & Hoffman 1993). Strathie & Hoffman (1993) determined that burrow depth of the prepupae is “correlated with body mass ($r=0.44$; $P<0.001$).” Once the prepupae stop burrowing, they form a hardened earthen pupal chamber by compacting the soil around themselves using writhing motions; here they overwinter. Prepupae are white to beige in color and darken once in their earthen chamber. Pupation occurs in the spring. Adults emerge in the summer, usually in late

June.

HOST PLANT ASSOCIATION

There is abundant host plant associations data available for *Rhyssomatus* Schoenherr, 1837 based both on digitized specimen vouchers and published literature records. According to these records, the following plant families are frequent *Rhyssomatus* hosts: Asclepiadaceae, Asteraceae, Bignoniaceae, Brassicaceae, Convolvulaceae, Fabaceae, Malvaceae, and Papilionaceae (Anderson, 2002; Cazado et al., 2013, Pierce, 1916; Santos, Zanuncio, Freitas, Alves, & Zanuncio, 2001).

Based on published, Darwin Core occurrence records (Ecdysis Portal 2023), specimen vouchers state that a majority of the plant record associations belong to the families Malvaceae and Asclepiadaceae, the latter being most prevalent. *Asclepias syriaca* (L.) tends to be the most documented species, most likely due to the plants' vast distribution (Franson & Willson, 1983; Van Zandt & Agrawal, 2004). However, there are records of feeding (by the adult and larvae) and ovipositioning on other species within *Asclepias* (L.); notably *A. exaltata*, *A. purpurascens*, *A. tuberosa*, *A. incarnata*, *A. verticillata*, *A. vifidiflora*, *A. amplexicaulis*, and *A. meadii* (Betz, 1989; Betz, Rommel, & Dichtl, 1997; Price & Wilson, 1979).

Although the 'pest'-label so often associated with certain species of *Rhyssomatus* is usually attributed to their destructive capabilities on agriculture crops, the last of the

aforementioned milkweeds, *Asclepias meadii* Torrey (known commonly as Mead's milkweed) was classified as a federally threatened prairie perennial by the United States Fish and Wildlife Service on September 1, 1988 (Betz, 1989; Edens-Meier et al., 2017). Funding by United State Fish and Wildlife Service through the Endangered Species Section 6 Grant E-15-R-1 and the Missouri Department of Conservation in association with The Nature Conservancy have conducted extensive conservation attempts within the last 22 years to reestablish the endangered milkweed within its documented natural range which had spanned "from Kansas eastward through Missouri and Illinois to northwest Indiana, and north into southern Iowa and northern Wisconsin" (Edens-Meier et al., 2017; Kettle, Alexander, & Pittman, 2000; Letsch, Balke, Toussaint, & Riedel, 2020; Tecic, McBride, Bowles, & Nickrent, 1998). Unfortunately, few of these reintroductions managed to produce established populations (Edens-Meier et al., 2017). Although Edens-Meier et al. points out several variables when considering these failed establishments, it was noted that the feeding and ovipositioning behavior on the roots and peduncle of flowering stems by *Rhyssomatus annectens* (Casey 1895-834) and *Rhyssomatus lineaticollis* (Say 1824-313) were major contributing factors (Betz, 1989; Betz et al., 1997; Edens-Meier et al., 2017).

FOSSIL RECORD

Found December 1961, there is one record of *Rhyssomatus* in the fossil record, *Rhyssomatus miocena* Pierce, 1965 (Koch, Santucci, & Weasma, 2004; Pierce, 1965). The fossil dates from the Upper Miocene era (11.63-5.33 Ma), from which the species

epithet was derived. The fossil in question was found by road excavators on Woodcrest Drive, off Sepulveda Boulevard, Los Angeles County, California, USA in a deposit of Altamira shale (site recorded as LACMIP 438) (Pierce, 1965). The author himself states that it was “tentatively” assigned to this genus, the reason for this hesitation is due to the fact that the record in question is a sole elytral impression (Pierce, 1965). Pierce (1965) argues that the “deeply punctate striae” on the elytra resembles that of *Rhyssomatus* (the author used the nomen nuda *Rhyssomatus* in his original text); the impression in question is 5.8mm long and 2.2mm wide [FIGURE 14]. Based on this author's assessment, the genus-level identification remains questionable, because the fossil in question is not diagnostic enough.



FIGURE 14: Habitus of *Rhyssomatus miocena*e Pierce, 1965, showing the elytral impression upon which its description was based.

ECONOMIC SIGNIFICANCE

Due to the generalist feeding and ovipositing tendencies and extensive plant

association it is no surprise that members of the genus are of considerable agricultural and economic significance.

United States is not having an impact in the United States as there are currently insufficient occurrence records of “pest” *Rhyssomatus* species infesting crops in the country to qualify them as established. However, this author strongly believes that the proximity to Mexico, where *Rhyssomatus nigerrimus* Fahraeus 1837 is firmly established, and increased demand for soybean (*Glycine max* (L.) Merrill; a known host of *R. nigerrimus* Fahraeus 1837 and *R. subtilis* Fielder 1937c) products within the United States will lead to establishments in the future.

The following economic significance section is divided into the following sequence of subsections: West Indies; Mexico; Central America; South America.

WEST INDIES

The presence of ‘the Mexican soybean weevil’, *Rhyssomatus nigerrimus* Fahraeus 1837-376, was confirmed at the island of St. Vincent in 2019 (Haseeb et al., 2019). Although Haseeb et al. does not expand upon the current distribution of the species on the island, its mere presence is enough cause for alarm. Dependency of the agricultural sector of Saint Vincent’s Gross Domestic Product (GDP) has been steadily increasing the past ten years with a current percentage of 7.15% (Plecher, n.d.) and according to Caribbean

Agricultural Research and Development Institute (CARDI) it accounted for 26% of the labor force (“Saint Vincent & the Grenadines – Caribbean Agricultural Research & Development Institute,” n.d.). The avid of COVID in 2020 and consequential decrease in the tourist industry may see a spike in agricultural significance in the years to come. CARDI reports that although banana is still considered the main crop of St. Vincent, there has been an increase in a number of root crops (i.e., cassava, eddoe, dasheen yam, and sweet potato), all possible hosts for *Rhyssomatus* (“Saint Vincent & the Grenadines – Caribbean Agricultural Research & Development Institute,” n.d.).

Occurrence records of *Rhyssomatus* sp. on other Caribbean islands such as Puerto Rico and Cuba, where root vegetables are also an important crop, suggest that the prevalence of this genus is much more widely distributed in the West Indies than the literature suggests; more information and specimens are needed (O’Brien & Wibmer 1982; Suffrain 1872).

MEXICO

Neotropical areas in the recent decades have seen a surge of destruction in agricultural soy (*Glycine max* (L.) Merrill) due to *Rhyssomatus* (Cazado et al., 2016; Guillermo López-Guillén, Valdez-Carrasco, Ruiz, Zarate, & Cruz-López, 2016).

Rhyssomatus nigerrimus Fahraeus 1837-376 was first reported in Mexico by Lopez-Guillen et al. in 2012. According to Lopez-Guillen et al., there was a recorded

183,981 tons of soybean produced in Mexico in 2011, in their paper they describe that after a three-year monitoring of *Glycine max* (L.) Merrill crops at Altamira, Tamaulipas, Mexico and El Manzano, Tapachula, Chiapas, *R. nigerrimus* was demonstrated to have caused substantial damage to soybean crops, with over 48% of soy pods being damaged at all sites observed, causing millions of dollars' worth of damage [GG4] (Delgado-García et al., 2016; G. López-Guillén et al., 2012).

The large number of undocumented, dispersed subsidiary farms and presence of 30 species within the country leads one to think that the genus may be more of a pest than previously thought. Loss to crops in rural areas and unidentified or misidentified damage is most likely prevalent.

CENTRAL AMERICA

Ipomoea batatas (L.) Lam., known locally as either yams or sweet potatoes, are of enormous importance in the West Indies where cultivation of the tuber as both a basic food item and industrial food crop has made it prevalent with both local small farms and large-scale agricultural establishments (Viale, 1951; Viale & Thomas, 1954). Studies conducted in Turrialba, Costa Rica by the Inter-American Institute of Agricultural Sciences describe an unknown species of *Rhyssomatus*, labeled as “near *Rhyssomatus subcostatus* Fahraeus 1837-368[GG5]”, to be responsible for a majority of the loss of the

annual sweet potato crop (Viale 1951; 1954). Damage by both adult and larvae are described, however it is the latter which dispenses the most destruction.

The larvae feed upon the roots and tuber of the plant which has the potential to kill the infected host and makes the crop inedible. Secondary infestation in storage by unknown infected tubers also poses a considerable threat to the market. As previously mentioned, there are only five (5) known species of *Rhyssomatus* in the West Indies (*R. aciculaticollis*, *R. crispicollis*, *R. ebeninus*, *R. nigerrimus*, *R. stangulatus*). Attempts to contact the Inter-American Institute of Agricultural Sciences have proven unsuccessful and so potential species identification is impossible.

There are references of damage done to the sweet potato crop in Costa Rica caused by *Rhyssomatus subcostatus* Fahraeus 1837 in checklists and agricultural books from the 1980s and early 1990s (King & Saunders, 1984; Saunders, King, & Vargas, 1983), however, more recent literature does not define it as a major pest (Coto, Saunders, Vargas, & King, 1995). This may be again, due to under sampling and misidentification.

With currently 28 species occurring in Central America and no natural barriers between countries, as with island separation in the West Indies, spread of the genus is most likely certain.

SOUTH AMERICA

South America is home to the majority of species belonging to *Rhyssomatus* and documented herbivory of agriculturally important crops has been established in the literature since the early 1930's (Anderson, 2002; Santos et al., 2001).

Glycine max (L.) Merr., or soybean, demand has been steadily rising around the world and is the main export of Argentina (Puricelli et al., 2016). In fact, the United States, Brazil, and Argentina make up 80% of the world production of soy with Argentina comprising 30% of this total (Zunino, Areco, & Zygadlo, 2012).

Rhyssomatus subtilis Fielder 1937c, common name 'the black soybean weevil', was first recorded on agricultural *Glycine max* (L.) Merr. in 2006 within the Santiago del Estero province (Cazado et al., 2013; Socías, Rosado-Neto, Casmuz, Zaia, & Willink, 2009). Subsequent examinations of the species' geographical distribution have progressively shown the species range expanding throughout the country (Socías et al., 2009). As with other cases of pest herbivory by members of this genus, adult feeding, ovipositioning behavior, and larval feeding by *Rhyssomatus subtilis* significantly damage all stages of the soybean plant and can cause an entire crop to have to be abandoned and reseeded. Damage was reported to extend across 541,000 ha. (Cazado et al., 2013).

As mentioned above, Brazil is also of huge importance to the global soybean industry and although *Rhyssomatus subtilis* is not, as of yet, considered a pest to these

countries agricultural sector there are occurrence records from as far back as the early 1930s showing that the species range does expand into this region and can pose a threat (Wibmer & O'Brien, 1986).

Although soybean is of such high importance to Brazil, it is not the only possible plant under threat from this genus. Santos et al. (2001) explains that a possibly new species of *Rhyssomatus* in Brazil is responsible for 23% and 6% (damage) during the first and second samplings, respectively of the native leguminous tree *Anadenanthera peregrina* Speg. (syn. *Piptadenia peregrina* (L.) Benth.); the curculionid feeds on the endosperm of the seeds and leaves them non-viable (Santos et al. 2001). Unfortunately, the contact information associated to the corresponding author is no longer viable, making it impossible to locate the samples used for determination within this particular study and I am therefore unable to verify whether the species is new or pre-existing. *Anadenanthera peregrina* Speg. is both important in cultivation and local culture in South America and the Caribbean for 1.) the pods which are used for their hallucinogenic qualities (the grounded pod powder is called “snuff” and inhaled for its hallucinogenic effects); 2.) bark which is used in the treatment of asthma and bronchitis and also used for its richness in tannins; and 3.) the heart and sapwood, used in overall construction. (Little et al. 1964; Little & Wadsworth, 1963; Mors, Rizzini, & Pereira, 2000; Santos et al., 2001; Uphof, 1959; Santos et al. 2001; Mors 2000; Uphof 1959).

In addition to the aforementioned species, *Rhyssomatus angustulus* Faust 1894a, *R. strangulatus* Gyllenhal 1837 (syn. *R. barioides* Fiedler 1937c), *R. scutellaris* Fiedler 1937c, *R. thoracicus* Fiedler 1937c are all considered pests of the Convolvulaceae throughout South America wherever they are found; Convolvulaceae is the botanical family that includes sweet potato and many tuberous plants as well as trees, shrubs, and vines used as ornamentals throughout the region (Santos et al. 2001; Lima 1956). *Rhyssomatus marginatus* Fahraeus 1837 is considered a pest of the South American legumes *Phaseolus vulgaris* L. and *Sesbania virgata* (Cav.) Pers. (syn. *S. marginata* Benth.) (Santos et. al. 2001).

As with many of the other geographical regions discussed, the ranges of the 135 *Rhyssomatus* species documented as occurring in South America are most likely much more extensive than currently recognized in the literature, further sampling will be required to ascertain true expansion.

USE AS A BIOCONTROL AGENT

Interestingly, the ‘destructive’ nature of the genus has been used successfully as a biocontrol agent in South Africa for the past twenty years with seemingly no detrimental effect.

Rhyssomatus marginatus Fahraeus 1837, a pest in South America, has been successfully introduced in South Africa as a biocontrol agent of the invasive South

American leguminous tree *Sesbania punicea* (Cav.) Benth. (Papilionaceae) [FIGURE 15] (Hoffmann & Moran, 1991, 1992, 1998; Hoffmann & Moran, 1999). In its natural home the tree is cultivated as a native ornamental, its large aesthetic red flowers made it an alluring for urban treescape in the Southeastern United States and South Africa (Pienaar, 1978). *Sesbania punicea* has become a noxious weed in both of these areas with significant damage being done in South Africa.

The earliest record of the leguminous tree in South Africa is from a 1858 plant list of the Cape Town Botanical Gardens, listed under its synonym *Daubentonia punicea*; it seems to have not caused significant damage in the area until the 1960s (Henderson & Anderson, 1966; McGibbon, 1858). The invasive has significantly increased erosion along rivers and water-courses while also impeding access by locals to their local water supplies due to its thicket-like growing nature; the tree also diminishes valuable water sources through transpiration (Hoffmann & Moran, 1998). Contemporary management strategies proved useless to control the spread of the legume due to its wind-pollinated, prolific nature; all parts of the plant are toxic and cannot be used by local herbivores for feed (Hoffman & Moran, 1988).



FIGURE 15: General habitus, vegetative structures of *Sesbenia punicea* (Cav.) Benth. (Papilionaceae) taken from Hoffmann & Moran, 1998.

Rhyssomatus marginatus was one of the original 18 insect species identified as potential biocontrol agents in 1972. However, work was not continued on this project until 1980 when 5 of the original 18 weevils (seed-feeder: *Rhyssomatus marginatus* and *Apion decipiens*; bud-feeder: *Trichapion lativentre* (Beguin-Billecocq); stem-boring: *Neodiplogrammus quadrivittatis* (Olover); root-feeder: *Eudiagogus episcopalis* (Schoenherr)) were selected as viable candidates for the project and shipped to South Africa (Hoffmann & Moran, 1998). In September of 1982, 8 months after the initial introduction, 3 weevil species were firmly decided upon: *Rhyssomatus marginatus*, *Trichapion lativentre*, and *Neodiplogrammus quadrivittatis*.

Rhyssomatus marginatus was included in the study due to its host specificity of *S. punicea* and *S. virgata* in Argentina. Studies documented that *R. marginatus* was able to destroy up to 90% of the seeds made by both of these leguminous trees (J. H. Hoffmann & Moran, 1991). In 1999 the project was reevaluated and it was found that *R. marginatus* proved invaluable as a control against the stand-alone populations of *S. punicea*, as opposed to *Trichapion lativentre* (Beguin-Billecocq) and *Neodiplogrammus quadrivittatis* (Oliver) which prepared the dense populations of the trees along waterways (Hoffmann & Moran, 1999). Destroying these smaller, separated stands leaves no chance of the invasive to regain its numbers and therefore makes *Rhyssomatus marginatus* an invaluable asset in the fight against *Sesbania punicea*.

NATURAL PREDATORS AND NATURAL PESTICIDE POSSIBILITIES

There are documented cases of the parasitoid wasp *Bracon rhysemati* Ashmead specifically targeting *Rhyssomatus lineaticollis* (Say 1824-313) in North America, this could potentially be a biocontrol agent for pest species in the future (Doane, 1908; St Pierre & Hendrix, 2003; Webster, 1889). In terms of biocontrol applications already in use, there are also fungal pathogens that have proven successful in controlling both natural and agriculturally occurring populations of *Rhyssomatus* (specifically *Rhyssomatus nigerrimus* and *Rhyssomatus subcostatus*), namely different isolates of *Beauveria bassiana* (Bals.) (King & Saunders, 1984; Ortiz, Ruiz, López-Guillén, López, & Mora, 2016). In spite of the existence and possible use of the methods discussed above, conventional pesticides are still the main weapon used against *Rhyssomatus*.

Zunino et al. (2012) proposed using essential oils, specifically lemon (*Citrus limon* L.), eucalyptus (*Eucalyptus globulus* Labill.), and orange (*Citrus sinensis* L. Osbeck) (Zunino et al., 2012). In the paper they concentrated on two species of pest weevil, *Sternechus pinuis* (Fabricius) and *Rhyssomatus subtilis* Fiedler, on which to apply these concentrated oils. Based on their analysis it was divulged that at low concentrations the oils were ineffective, however mortality increased rapidly at 0.63 μ L/cm² and induced 100% mortality at the 24 hour interval when the highest dose tested (5 μ L/cm²) was applied (Zunino et al., 2012). They concluded with stating the positives of using such a method in place of conventional pesticides: 1) the distilled oils can be extracted easily; 2) they are safer for the applicant; 3) they are volatile and will therefore persist for less time in the natural environment, their volatile nature also allows them to be used as fumigants (Zunino et al., 2012). Although this method seems promising, there are no examples of real-world application in the literature.

CHAPTER 2: SPECIES RANGE EXPANSIONS

The following chapter is divided into the following sequence of subsections:
Methods: Sampling; Results.; Discussion.

METHODS: SAMPLING

From the thirty-three institutions contacted, the following collections sent physical specimen loans to be evaluated and catalogued (Arnett, Samuelson, Nishida, 1993):

ASUCOB	Arizona State University Charles W. O'Brien Collection
ASUHIC	Arizona State University Hasbrouck Insect Collection
CAS	California Academy of Sciences; USA
CMNC	Canadian Museum of Nature; Ottawa, Canada
FMNH	Field Museum of Natural History; USA
FSCA	Florida State Collection of Arthropods; USA
HNHM	Hungarian Natural History Museum; Budapest, Hungary
INHS	Illinois Natural History Survey; USA
LACM	Los Angeles County Museum; USA
MCZ	Harvard Museum of Comparative Zoology; USA
RBINS	Royal Belgian Institute of Natural Science; Brussels, Belgium

RESULTS

Most recent species lists recognize 175 species of the New World weevil *Rhyssomatus* Schoenher, 1837 (Curculionidae: Molytinae: Cleoginini) with the distribution as 48 species in North America including Canada and Mexico, Central America, and West Indies (United States: 17; Mex.: 27; Can.: 1; Cen. Amer.: 25; West Indies: 5) and 133 in South America. (O'Brien & Wibmer, 1982; 1986).

However, additional occurrence data obtained from Symbiota Collections of Arthropods Network (SCAN), Ecdysis Portal network, and previously undetermined specimens from institutions have changed these data. The following 5 tables display new ranged expansions for the United States (Table 1), Mexico (Table 2), Canada (Table 3), Central America (Table 4), and the West Indies (Table 5). The left-hand column of each table lists the original species within of the aforementioned localities with specific distributions stated where possible. The right-hand column lists the species that are new to each region with corresponding catalogue numbers.

Table 1: Novel range distribution of *Rhyssomatus* in the United States.

Original Distribution (O'Brien et. al 1982)	New Range Expansions Based on Entries from Symbiota and Ecdysis Portal network
<i>R. acutecastatus</i> : AZ	<i>R. puncticollis</i> : TX (AUMNH:ENT199416; AUMNH:ENT199417)
<i>R. aequalis</i> : CT, DC, IL, IN, MD, OH, PA, MS, IA, KS, ND, SD	

<i>R. annectens</i> : IL, IN, MD, NY, OH, SC, TX	
<i>R. arizonicus</i> : AZ	
<i>R. beutenmuelleri</i> : NC	
<i>R. fissilis</i> : TX	
<i>R. grandicollis</i> : IA	
<i>R. lineaticollis</i> : CT, DC, IL, IN, MA, MI, NJ, NY, PA, WI, AR, FL, GA, LA, MS, NC, SC, VA, TX, UT, IA, KA, MN, MO, ND, NE, SD	
<i>R. medialis</i> : AZ, NM, TX	
<i>R. oculatus</i> : AZ	
<i>R. ovalis</i> : TX	
<i>R. palmacollis</i> : DC, IN, NJ, OH, PA, AR, FL, MS, NC, SC, TN, TX, KS	
<i>R. parvulus</i> : AZ, NM, TX	
<i>R. pruinus</i> : AZ, BJ, CA, NM, TX	
<i>R. rugulipennis</i> : AZ, NM, TX, UT	
<i>R. texanus</i> : OK, TX	

Table 2: Novel range distribution of *Rhyssomatus* in Mexico.

Original Distribution (O'Brien et. al 1982)	New Range Expansions Based on Entries from Symbiota and Ecdysis Portal network
<i>R. acutecastatus</i>	<i>R. medialis</i> : MX (ASUCOB0000050; ASUCOB0000051; ASUCOB0000052; ASUHIC0089704)

<i>R. biseriatus</i>	<i>R. pubescens</i> : MX (ASUHIC0091387; ARTSYS0008093; ARTSYS0008094; ARTSYS0008095)
<i>R. crenatus</i>	<i>R. tenuirostris</i> : MX (MCZ681875)
<i>R. debilis</i>	
<i>R. dilaticollis</i>	
<i>R. morio</i>	
<i>R. nigerrimus</i>	
<i>R. nitidus</i>	
<i>R. ovalis</i>	
<i>R. palmacollis</i>	
<i>R. parvulus</i>	
<i>R. perparvulus</i>	
<i>R. pilosus</i>	
<i>R. productus</i>	
<i>R. pruinosus</i>	
<i>R. punctatosulcatus</i>	
<i>R. puncticollis</i>	
<i>R. rufus</i>	
<i>R. yucatanus</i>	

Table 3: Novel range distribution of *Rhyssomatus* in Canada.

Original Distribution (de Tonnancour et al., 2017)	New Range Expansions Based on Entries from Symbiota and Ecdysis Portal network
<i>R. aequalis</i> : Quebec	<i>R. lineaticollis</i> : Ontario (ASUCOB0008492; ASUCOB0008493; ASUHIC0127640; ARTSYS0008016); Quebec (ARTSYS0008017); Ottawa (ARTSYS0008054)
	<i>R. palmacollis</i> : Yukon (ARTSYS0008064)

Table 4: Novel range distribution of *Rhyssomatus* in Central America.

Original Distribution (Wibmer et. al 1986)	New Range Expansions Based on Entries from Symbiota and Ecdysis Portal network
<i>R. acutecastatus</i> : Guat., Hond.	<i>R. rugulipennis</i> : Pan. (ARTSYS0008125)
<i>R. alternans</i> : Pan.	
<i>R. biseriatus</i> : Guat.	
<i>R. crenatus</i> : Pan.	
<i>R. debilis</i> : Guat., Hond., Nic., Pan.	
<i>R. dilaticollis</i> : Hond., Pan.	
<i>R. laticollis</i> : Guat.	
<i>R. latipennis</i> : Guat.	
<i>R. latus</i> : Pan.	
<i>R. nigerrimus</i> : Belize, Guat.	
<i>R. nitidus</i> : Pan.	

<i>R. ovalis</i> : Pan.	
<i>R. perparvulus</i> : Guat., Pan.	
<i>R. pruinosus</i> : Hond.	
<i>R. punctatosulcatus</i> : Guat.	
<i>R. puncticollis</i> : Belize, Hond.	
<i>R. rufescens</i> : Pan.	
<i>R. rufus</i> : Belize, Hond., Nic.	
<i>R. rugosus</i> : Belize, Guat.	
<i>R. sculpturatus</i> : Guat.	
<i>R. semicostatus</i> : Bol., Col.	
<i>R. sexcostatus</i> : El Salv., Nic., Pan.	
<i>R. strangulatus</i> : Pan.	
<i>R. subcostatus</i> : Belize, Guat., Hond., Nic., Pan.	
<i>R. subrufus</i> : Hond.	
<i>R. vehemens</i> : “America meridionalis”	

The West Indies has only one newly documented species of *Rhyssomatus* which? in addition to the four (4) cited in O’Brien and Wibmer (1982) However, this is most likely due to under-sampling as there is documentation of ‘near-*Rhyssomatus* sp. or new

species' attacking agricultural crops in the literature (Haseeb, Dosunmu, Kanga, O'Brien, & Zhang, 2019; Viale, 1951; Viale & Thomas, 1954).

Table 5: Novel range distribution of *Rhyssomatus* in the West Indies.

Original Distribution (O'Brien et. al 1982; (Wibmer et. al 1986))	New Range Expansions Based on Entries from Symbiota and Ecdysis Portal network
<i>R. aciculaticollis</i>	<i>R. niggerimus</i>
<i>R. crispicollis</i>	<i>R. pubescens</i>
<i>R. ebeninus</i>	<i>R. tenuirostrus</i>
<i>R. strangulatus</i>	

DISCUSSION

Wibmer & O'Brien's 1982 and 1986 checklists originally listed 5 species with ranges in both North America (*sensu lato*) and South America; specifically, *Rhyssomatus productus* Fiedler 1937c, *Rhyssomatus sculpturatus* Champion 1904, *Rhyssomatus semicostatus* Boheman 1845, *Rhyssomatus strangulatus* Gyllenhal 1837, and *Rhyssomatus subrufus* Champion 1904. Records included from this study now include *Rhyssomatus alternans* Champion 1904 and *Rhyssomatus laticollis* Champion 1904. Therefore, the total number of South American *Rhyssomatus* species has grown from 133 to 135.

Rhyssomatus marginatus Fahraeus 1837 is the only *Rhyssomatus* species with records extending out of the New World to South Africa. This is due to its use as a

biocontrol agent of the invasive leguminous tree *Sesbania punicea* (Cav.) Benth. (Papilionaceae) which has been expanded upon in this review under the section labeled 'Use as Biocontrol' (J. H. Hoffmann & Moran, 1991, 1992, 1998; John H Hoffmann & Moran, 1999; Strathie & Hoffmann, 1993).

Likewise, the presently documented species of North America (*R. acutecastatus*, *R. aequalis*, *R. annectens*, *R. arizonicus*, *R. beutenmuelleri*, *R. fissilis*, *R. grandicollis*, *R. lineaticollis*, *R. medialis*, *R. oculatus*, *R. ovalis*, *R. palmacollis*, *R. parvulus*, *R. pruinus*, *R. pubescens*, *R. puncticollis*, *R. rugulipennis*, *R. texanus*) have not been treated since 1895 by Casey and Casey's work only included ten of the now 18 recognized species (Casey, 1892; O'Brien & Wibmer, 1982).

My recent work on *Rhyssomatus* specimens has expanded the distributional range of previously lower latitude *Rhyssomatus* species northwards. *Rhyssomatus* can be considered one of the greatest agricultural threats of the next decade if left unchecked (as explained in the section titled Economic Significance) and, as previously stated, there is little to no work recently published on the genus to help facilitate correct identification.

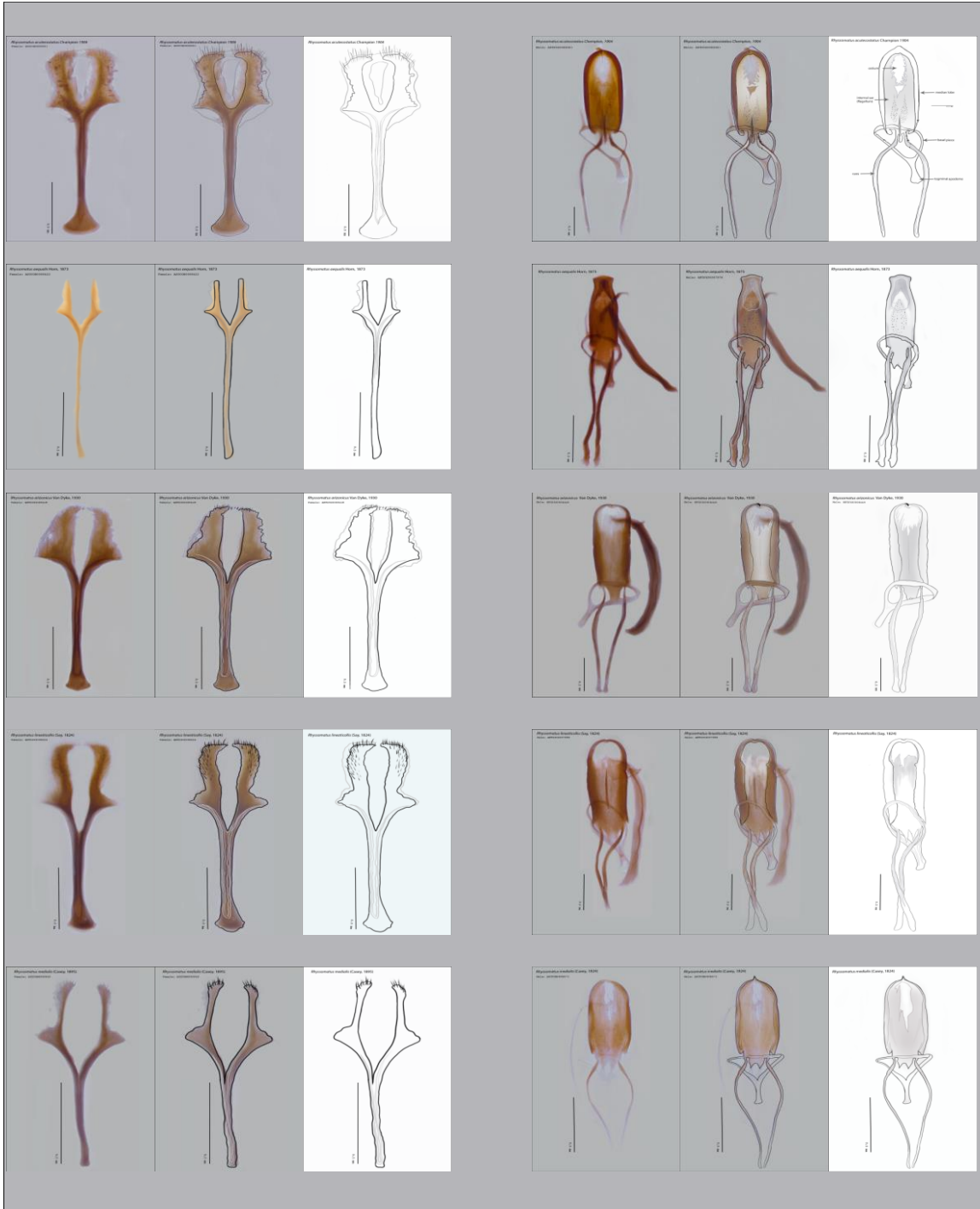


FIGURE 16: Female and male genitalia of *Rhyssomatus* species Scale bar = 0.5mm.

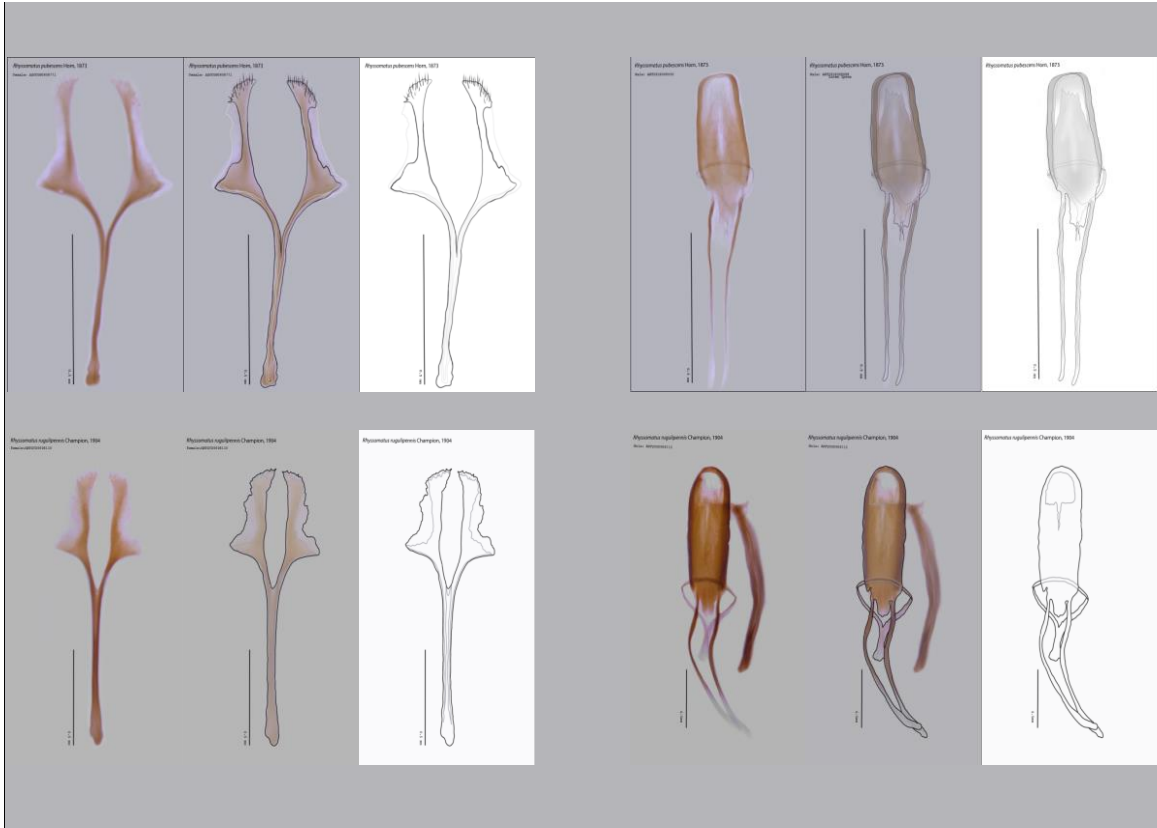


FIGURE 18: Female and male genitalia of *Rhyssomatus* species Scale bar = 0.5mm.

CHAPTER 3: DIAGNOSTIC KEY AND DESCRIPTIONS OF THE *RHYSSOMATUS* OF ARIZONA

The following chapter is divided into the following sequence of subsections: methods for morphological analysis; diagnostic key of the *Rhyssomatus* of Arizona; species descriptions

METHODS FOR MORPHOLOGICAL ANALYSIS

Observations of morphological structures were observed using a Leica M205C microscope and with Leica MEB126. Habitus images were taken with an EOS7D Canon Camera with a combination of 1.4x and 100mm lenses mounted on a Camlift Imaging System, slices were stacked in Zerene Stacker version 1.04. Images were edited in Adobe Photoshop Version 20.0.6. Plates were created on Adobe Illustrator version Adobe SFL 1.1.0.40922 79.270542. The morphological terminology used herein follows Torre-Buenno (Nicolas, 1989) and the Handbook of Zoology (Lawrence et al., 2010). Male and female terminalia are described using the terminology of Howden (1995).

Measurements were taken using stack photos obtained from the lateral, frontal, posterior, ventral, and dorsal angles, as needed. The number of individuals measures per gender and species is specified once in (if enough specimens were available). Stack photos were produced using the following system: Leica M205C Application Suite, Version 4.1.0, with a DiC450 Camera, Twain Version 7.6.0.0. The overall specimen length was measured in dorsal view, spanning from the apex of its head to the posterior margin of the elytra. The rostrum length was measured from its apex to the anterior

margin of the eye. Repeated descriptions of invariable features amongst species were omitted where possible.

Female and male terminalia were observed via dissections. For dissections, the specimens were first softened for 10-20 minutes in hot water (120 degrees Fahrenheit). Dissected abdomens were then placed in warm 10% KPH solution for a few minutes to digest the soft tissue. Genitalia were then removed and mounted on slides with glycerin. Drawings of male and female terminalia were prepared using the digital photographs previously mentioned and redrawing them with a Huion INSPIROY H640P Digital Graphics Drawing Pen Tablet and Adobe Photoshop Version 20.0.6 software.

DIAGNOSTIC KEY OF THE *RHYSSOMATUS* OF ARIZONA

1a. Alternate intervals of the elytra carinate; sternite 8 with fan-like flanges along entirety (i.e branches and stem), distal apex of stem fan-like, stem longer than apical branches, no globular formations on apices of branches; sternite 8 with reduced fan-like flanges on apical margins and little to none on stem, no globular formation on apices of sternite 8, stem longer or of equal length to branches; sternite 8 with no fan-like flange on branches, stem with little to no flange like projections at base, no globular formation on apices of sternite 8 ... ***Rhyssomatus 2***

1b. Alternate intervals of the elytra not carinate; sternite 8 with no flange, stem half as long as apical branches... **Subgenus *Sermysatus 10***

2a. Sternite 8 apical branches with fan-like flanges... **3**

2b. Sternite 8 apical branches with no flange.... **9**

3a. Body, head, and legs with conspicuous long, yellowish setae either overall or in patch-like distribution; sternite 8 with reduced fan-like flanges, limited to base of the apical branches, stem possessing no flange... **4**

3b. Body, head, and legs glabrous or with sparse, short, bristle-like setae; sternite 8 with fan-like flange on either apical branches and stem or both... **6**

4a. Rostrum stout and broad; setae short, yellowish in color and arranged in dense, patch-like clusters along elytra; scutellum covered in dense, short yellow setae... **R.**

palmacollis

4b. Rostrum slender; setae not in patch-like clusters along elytra...**5**

5a. Intermediate intervals of elytra feebly and incompletely carinate; setae unevenly distributed across pronotum and elytra (sparse areas intermixed with denser patches); median carina of pronotum distinct; scutellum densely covered in yellow setae... **R.**

medialis

5b. Alternate elytral intervals are flat; pronotum obliquely corrugated; setae evenly distributed across pronotum and elytra; median carina, if present, feeble; scutellum sparsely covered in short, yellow-ish setae... **R. pubescens**

6a. Pronotum conical, rapidly narrowing from the base; pronotum obliquely rugose, densely punctate (especially on the anterior and sides) between the elevated lines; distinct, sharp longitudinal medial carina on pronotum; prominent humeri forming an almost continuous outline with sides of pronotum... *R. acutecostatus*

6b. Pronotum not as previously described (“conical, rapidly narrowing from the base”) and longitudinally corrugated... **7**

7a. Setae within punctures on femur and tibia long, extending from puncture and yellow in color; tarsal pulvillus with dense yellow setae; base of sternite 8 without a paddle-like flange... *R. rugulipennis*

7b. Base of sternite 8 with distinct paddle-like flange... **8**

Descriptions of couplets read well! But no need for all this indentation. Ok to just use full width of page for each couplet. They are numbered.

8a. Feeble humeri, with the sides of the prothorax and elytra almost straight ... *R. arizonicus*

8b. Prominent humeri, creating distinct bulge in the dorsal profile of the sides of the elytra... *R. lineaticollis*

9a. Eyes nearly contiguous; over-all color dull-lustrous black with sparse yellow setae on head, elytra, abdomen, and legs; sternite 8 with no flange (thin and delicate), stem twice or three times as long as apical branches... *R. aequalis*

9b. Eyes widely separated; pronotum coarsely punctate; overall color ferruginous; sternite 8 apical branches with globular formations on apices, stem of sternite 8 twice as long as apical branches... ***R. oculatus***

10a. Eyes nearly contiguous or narrowly separated; apical margin of prothorax with distinct crista; prothorax obliquely corrugated with interstices punctate; rostrum distinctly depressed at junction of base and head, strongly curved; rostrum very slender, rutilous; sternite 8 apical branches distinctly bowed medially in an outward position, stem less than half the length of apical branches; overall color fuseo-testaceous to helvolous... ***R. pruinus***

10b. Eyes widely separated; pronotum obliquely corrugated with interstices punctate; rostrum contiguous from head or scarcely depressed, feebly or moderately curved... **11**

11a. Length 3-4 mm (smallest of the Arizona occurring *Rhyssomatus*), body over-all narrowly oval; abdomen moderately punctate, punctures separated by the punctures diameter or more; sternite 8's apical branches both distinctly bowed medially in an outward position, stem less than half the length of apical branches; overall color fuseo-testaceous to reddish-yellow ... ***R. parvulus***

11b. Length 3-5 mm, body broadly oval; abdomen distinctly punctate, punctures separated by less than the punctures diameter; sternite 8's apical branches not distinctly bowed medially in an outward position; apical branches of sternite 8 extended from basal

apex with straight sides, stem less than half the length of apical branches; overall color fuseo-testaceous to reddish-yellow... *R. ovalis*

SPECIES DESCRIPTIONS

Rhyssomatus acutecostatus Champion, 1904

= *Rhysematus acutecostatus* [Van Dyke 1930:163]

Holotype. Type in The Natural History Museum of London (HNMUK); UK, England, London.

Diagnosis.

The species was originally described as only occurring in Mexico and Guatemala by Champion (1904), contemporary records extend this range to Arizona, Mexico, Texas, Guatemala, Panama, Nicaragua, Costa Rica, and Colombia. It is easily separated from other North American species by its distinct pronotum which is conical, rapidly narrowing from the base and possesses a distinct, sharp longitudinal medial carina and prominent humeri which forms an almost continuous outline with the sides of the pronotum. It most closely resembles *Rhyssomatus subcostatus* Fahraeus, 1837 with ranges overlapping in Guatemala, Mexico and Panama. It can be easily separated from *R. subcostatus* by the alternate elytral interstices which in *R. acutecostatus* are complete and sharply costate. In addition, the eyes of *R. acutecostatus* are less approximate and the rostrum is usually shorter and more stout than in *R. subcostatus* (Champion, 1904).

Redescription.

Habitus. **Male:** Length 6.12-8.32 mm, width 3.29-4.44 mm, length/width ratio 1.86-1.88 (N=3). **Female:** Length 8.44-8.54 mm, width 4.47-4.62 mm, length/width ratio 1.82-1.87 (N=3). Body Integument fuscous, body glabrous, sparsely covered in bristle-like, yellow setae with legs gradually becoming more pubescent at the distal apex of tibia. Prominent humeri almost continuous with prothorax. Alternate intervals of elytra carinate, shallow depressions (fovaea) are found at interstria 3, 5, 7, 9 from the base to the apex, 8 and 10 at the base; fovea with lateral, evenly spaced, ovate punctures. Aforementioned interstices 3, 5, 7, 9 sharply costate, remaining interstices relatively smooth.

Head. Head with eyes narrowly separated (approximately the width of 7-9 facets), eyes recessed, slightly laterally compressed, medially tapering to a blunt angle, distal portion wide and continuous to pronotum. Head densely punctate with a corrugated appearance, sparsely covered in short yellow setae.

Antennae. Scrobe laterally descending, antenna inserted 1/3 from distal apex of rostrum. Funicle with 8 flagellomeres, club ovoid in shape, compressed, pubescent.

Mandibles. Decussate and bifurcated.

Rostrum. **Male:** Length 2.2-3.03 mm, rostrum/pronotum length ratio 1.33-2.18, rostrum length/width ratio 4.63-5.84. **Female:** Length 2.72-2.87mm, rostrum/pronotum length ratio 1.32-1.48, rostrum length/width ratio 4.07-4.68. Base portion of rostrum as wide as head before slightly tapering, width of rostrum continuous and ends in blunt sub-rhomboidal apex; rostrum stout, moderately curved in lateral view. Punctate, punctures separated by slightly more than a punctures diameter. Strong medial carina that extends

between the eyes before bifurcating and quickly tapering, flanked laterally by multiple carini at basal half.

Pronotum. **Male**: Pronotum length/width ratio 0.66-0.69, pronotum/elytra length (not including elytral curvature) ratio 0.35-0.40. **Female**: Pronotum length/width ratio 0.63-0.67, pronotum/elytra length (not including elytral curvature) ratio 0.31-0.35. Pronotum conical, rapidly narrowing from the base, obliquely rugose, densely punctate (especially on anterior and lateral segments) between elevated lines. Covered in sparse short yellow setae. Possess distinct, sharp medial carina.

Scutellum. Oval in shape, glabrous, approximately 1.5-2 x longer than wide, recessed into elytra, lateral groves sometimes with sparse short yellow setae.

Legs. **Male**: Profemur/pronotum length ratio 1.07-1.23; protibia/profemur length ratio 0.65-0.94. **Female**: Profemur/pronotum length ratio 0.84-0.90; protibia/profemur length ratio 0.62-0.73. All six legs with anteromesal tooth present, slightly curved, anteromesal projection of protibia distinct, dense yellow setae present in longitudinal rows.

Elytra. **Male**: Elytra length/width ratio 2.43-2.68. **Female**: Elytra length/width ratio 2.57-3.00. Shape ovate to subtriangular, prominent humeri forming an almost continuous outline with sides of pronotum

Terminalia. **Male**: Terminalia with tegmen similar in length to median lobe (have to look at dissection, photo I have does not have tegmen). Aedeagus lateral margins with slight declivity before converging at the basiventral margin, basiventral margin widely emarginate, lobe-like projections subtriangular. Lateral margins nearly straight and roundly converging towards apex. **Female**: Sternite 8 with fan-like flange along entirety,

on apical branches and stem (i.e. branches and stem), stem longer than apical branches, no globular formations on apices of branches.

Etymology. The Latin term *acutecostatus* means “sharply ribbed,” and may refer to the many raised, oblique lines (i.e. strongly corrugated appearance) of the pronotum.

Material Examined.

ARTSYS0008401 - ARTSYS0008407; ARTSYS0011026 - ARTSYS0011027.

ASUCOB0008401; ASUCOB0008470 - ASUCOB0008472; ASUCOB0022960 - ASUCOB0022980; ASUCOB0023059; ASUCOB0023085 - ASUCOB0023086.

ASUHIC0127582.

MCZ-ENT00681909; MCZ-ENT00681921; MCZ-ENT00681934; MCZ-ENT00681936 - MCZ-ENT00681937.

Habitat Range.

United States: Arizona, Texas; Mexico; Guatemala; Honduras; Nicaragua; Costa Rica; Panama; Colombia.

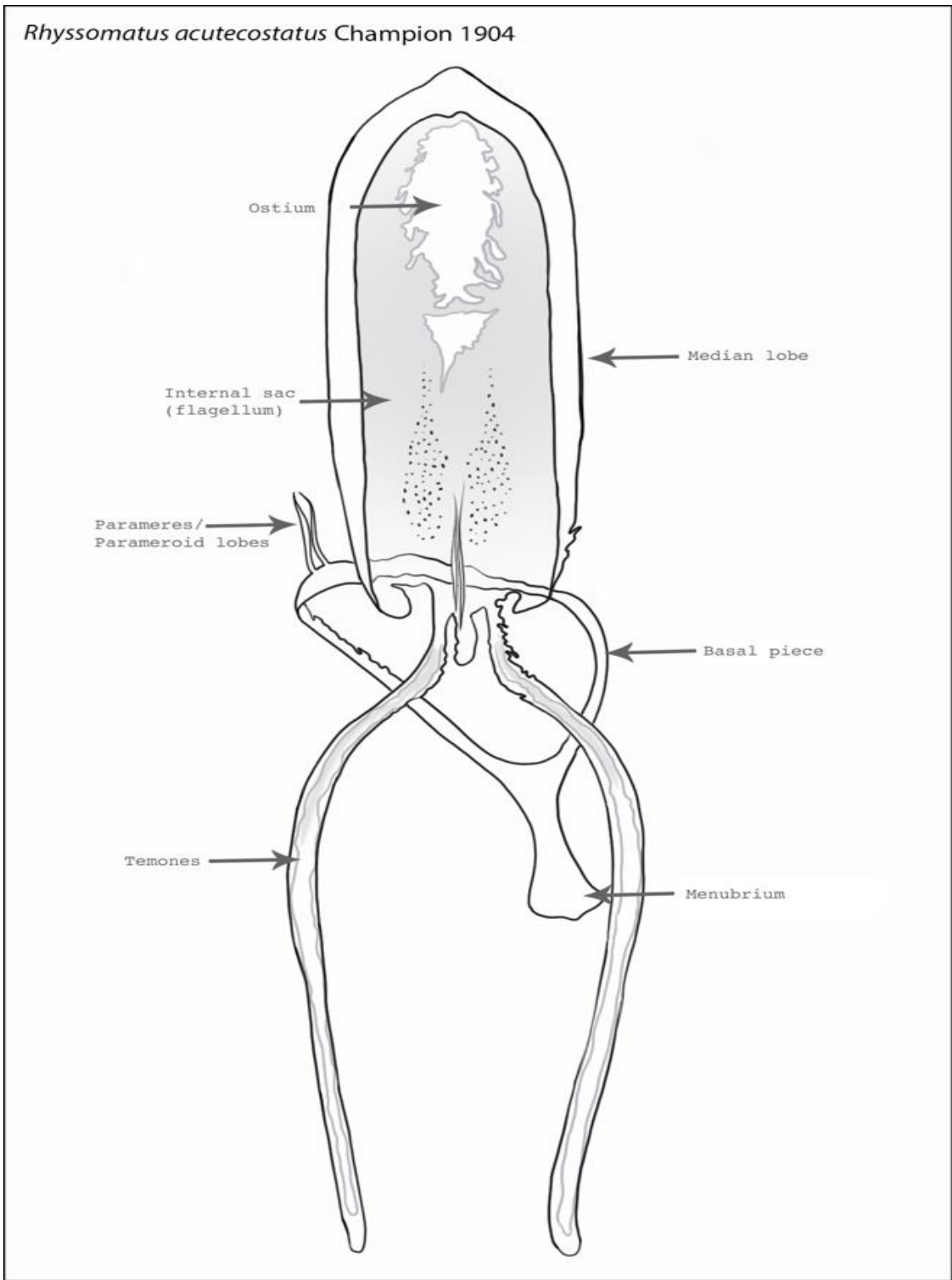


FIGURE 19: *Rhyssomatus acutecostatus* male genitalia.

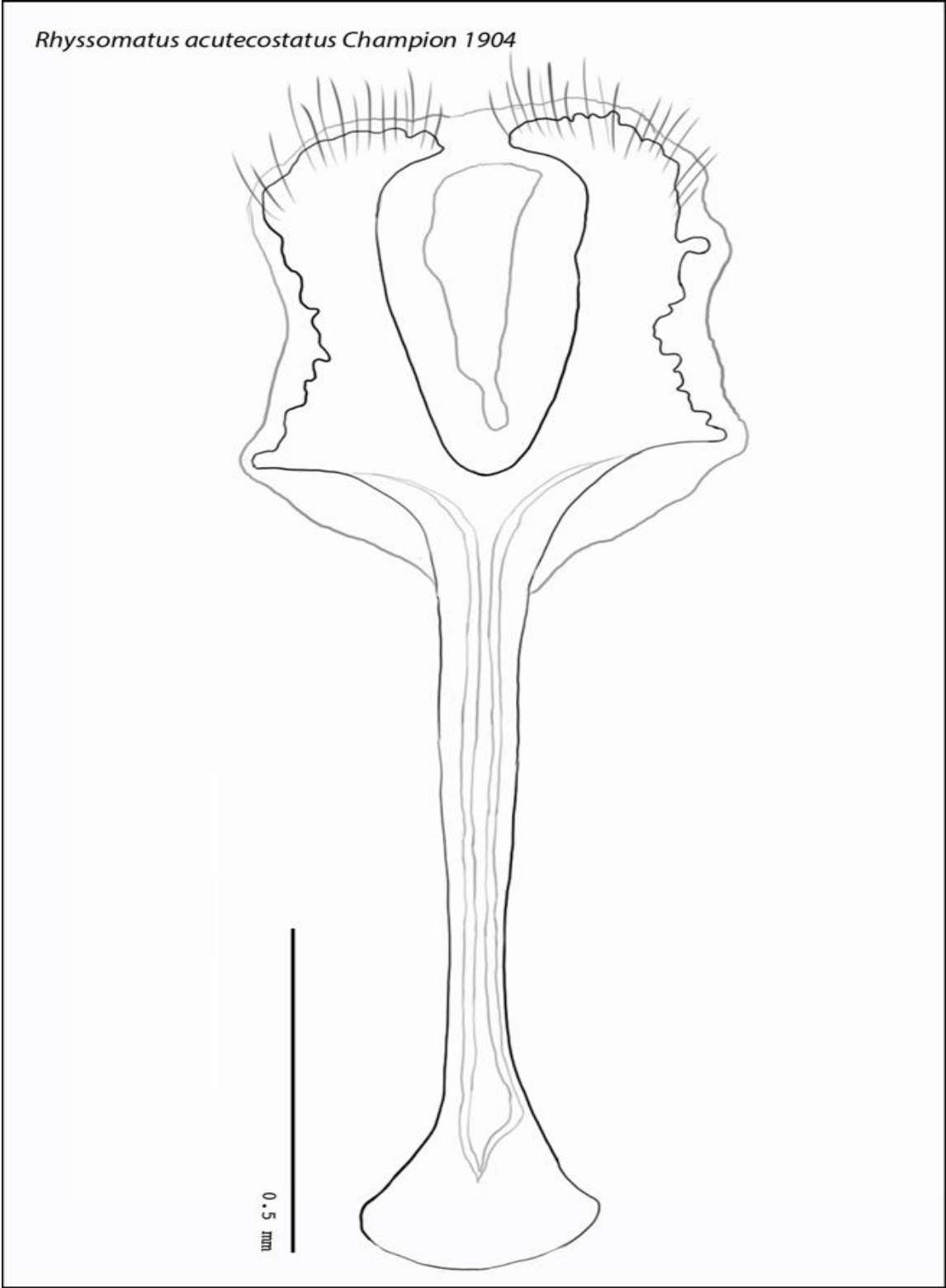


FIGURE 20: *Rhyssomatus acutecostatus* female genitalia.



FIGURE 21: *Rhyssomatus acutecostatus* dorsal image.



FIGURE 22: *Rhyssomatus acutecostatus* lateral image.



FIGURE 23: *Rhyssomatus acutecostatus* frontal image.



FIGURE 24: *Rhyssomatus acutecostatus* distributional map of Arizona; sourced from Ecdysis Portal. 2023.

Rhyssomatus aequalis Horn, 1873

= *Rhyssomatus aequalis* [Popenoe 1877:85], [Austin 1880:50], [Blatchley & Leng 1916:484], [Hayes 1919:211], [Malkin 1941:291], [Downie 1958: 158]

Holotype. Type in California Academy of Sciences (CAS); USA, California, San Francisco.

Diagnosis. Horn's (1873) original description of *Rhyssomatus aequalis* was based upon specimens from Pennsylvania, Illinois, and Kansas. Malkin (1941), Downie (1958), and de Tonnancour et al. extend this range to include New Jersey, USA, Indiana, USA, and Quebec, Canada. While Ecdysis (2021) and SCAN (2021), from specimen vouchers dating from 1900-2020 include Florida, Georgia, Alabama, South Carolina, Kentucky, Michigan, Wisconsin, New Jersey, New York, Connecticut, Delaware, Massachusetts, Louisiana, Missouri, Minnesota, Oklahoma, Montana, Arizona, and Washington, in addition to all aforementioned localities. Female genitalia distinct, speculum ventral with no flange (thin and delicate), stem twice or three times as long as apical branches. Alternate intervals of elytra carinate place the species in *Rhyssomatus* sensu stricto.

Redescription.

Habitus Male. Length 3.68-4.59 mm, width 3.68-4.59 mm, length/width ratio 1.94-2.29, elytra length/width ratio 2.73-2.83 (N=4). **Female.** Length 3.72-4.46mm, width 1.81-2.23mm, length/width ratio 1.97-2.05, elytra length/width ratio 2.88-3.51 (N=3).

Integument dull-lustrous black; head, elytra, legs sparsely covered in short setae, irregularly dispersed. Alternate intervals of elytra carinate, remaining interstices nearly flat and possess two (2) irregular rows of punctures with short bristle-like yellow setae, delineating this species to *Rhyssomatus* sensu stricto. Humari prominent, creates a distinct bulge in dorsal profile. In lateral profile this species has a distinct ‘hunched’ appearance as a result of the basal half of the thorax being vertically wider than long before rapidly curving and constricting at basal apex.

Head. Head with eyes narrowly separated (approximately the width of 3-4 facets), eyes recessed, slightly laterally compressed, medially tapering to a blunt angle, distal portion wide and continuous to pronotum.

Antennae. Scrobe laterally descending, antenna inserted 1/3 from distal apex of rostrum. Funicle with 8 flagellomeres, club ovoid in shape, compressed, pubescent.

Mandibles. Decussate and bifurcated.

Rostrum. **Male:** Rostrum length 0.97-1.34 mm, rostrum length/width ratio 3.23-4.62, rostrum/pronotum length ratio 1.22-1.35. **Female:** Rostrum length 1.13-1.51 mm, rostrum/pronotum length ratio 1.44-1.48, rostrum length/width ratio 4.03-5.39. Rostrum sparsely punctate at apex, base carinate, flanked laterally by multiple carina at basal half.

Pronotum. **Male:** Pronotum length/width ratio 0.54-0.63, pronotum/elytra length (not including elytral curvature) ratio 0.28-0.34. **Female:** Pronotum length/width ratio 0.58-0.64, Pronotum/elytra length ratio 0.29-0.33. Pronotum obliquely rugose with sparse yellow setae irregularly dispersed. If present medial pronotal carinae feeble.

Scutellum. Scutellum circular, punctate with small yellow setae; recessed into elytra.

Legs. Male: Profemur/pronotum length ratio 1.10-1.39, protibia/profemur length ratio 0.70-0.80. **Female:** Profemur/pronotum length ratio 1.09-1.40, protibia/profemur length ratio 0.72-0.98. Protibia with anteromesal tooth present, slightly curved, anteromesal projection of protibia distinct, sparse yellow setae present in longitudinal rows.

Terminalia. Male: Terminalia with tegmen similar in length to median lobe. Aedeagus lateral margins with abrupt declivity before converging at the basiventral margin, basiventral margin emarginate, lobe-like projections acutely subtriangular. Lateral margins from 2/3 of way from base to apex straight, constriction at apical half gives a ‘bottle-like’ appearance. **Female:** Sternite 8 with no flange (thin and delicate), stem twice or three times as long as apical branches.

Etymology. The Latin term *aequalis* means “equal.” In his original description Horn (1873) references the name being attributed to the carinate intervals on the elytra, although he does state “(T)he intervals are not absolutely equal, some are flat the others slightly convex but the difference is not sufficient to be noticed readily, and the intervals being thus equal the short carina at the humerus disappears.”

Material Examined.

ARTSYS0007875; ARTSYS0007877 - ARTSYS0007912; ARTSYS0008408 -

ARTSYS0008439

ASUCOB0008404; ASUCOB0008418 - ASUCOB0008466.

ASUHIC0127751 - ASUHIC0127752.

FMNHINS3134596; FMNHINS3739523 - FMNHINS3739533; FMNHINS3740163;
FMNHINS4188135 - FMNHINS4188172.

MCZENT00603316; MCZENT00682027 - MCZENT00682030.

Habitat Range.

United States: Florida, Georgia, Alabama, Mississippi, South Carolina District of
Columbia, Kentucky, Ohio, Indiana, Illinois, Michigan, Wisconsin, Pennsylvania, New
Jersey, New York, Connecticut, Delaware, Maryland, Massachusetts, Louisiana, Missouri,
Iowa, Minnesota, Oklahoma, Kansas, North Dakota, South Dakota, Montana, Arizona,
Washington; Canada: Ontario, Quebec.

Rhyssomatus aequalis Horn, 1873

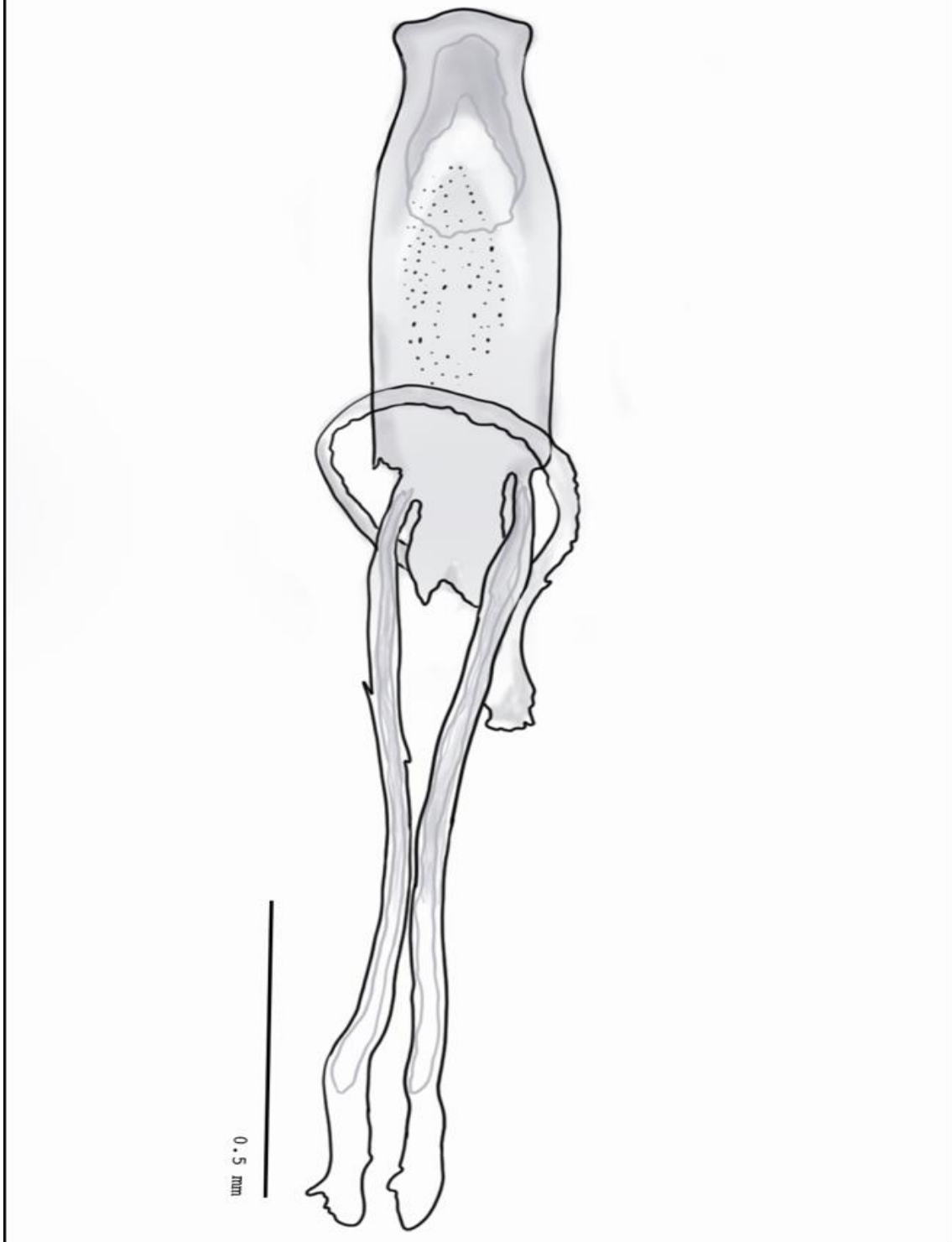


FIGURE 25: *Rhyssomatus aequalis* male genitalia.

Rhyssomatus aequalis Horn, 1873

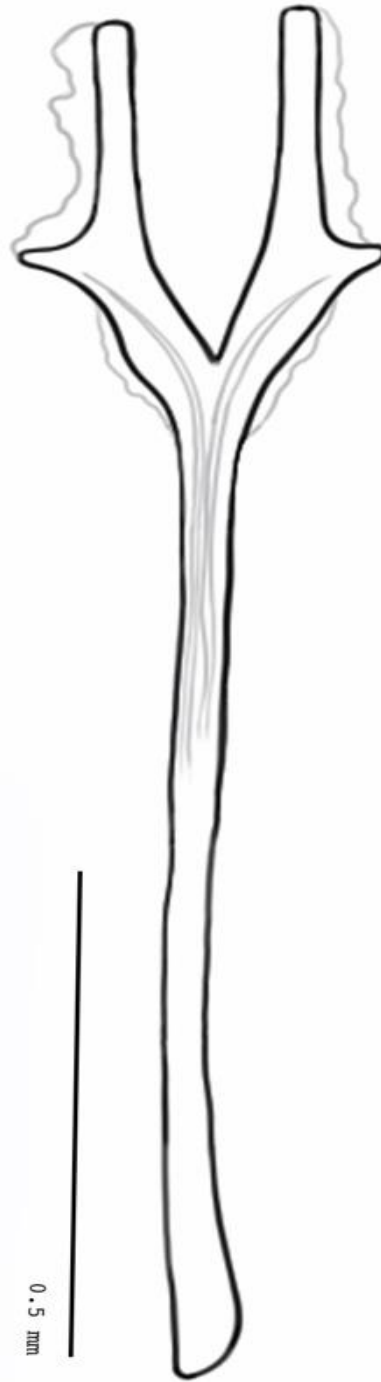


FIGURE 26: *Rhyssomatus aequalis* female genitalia.

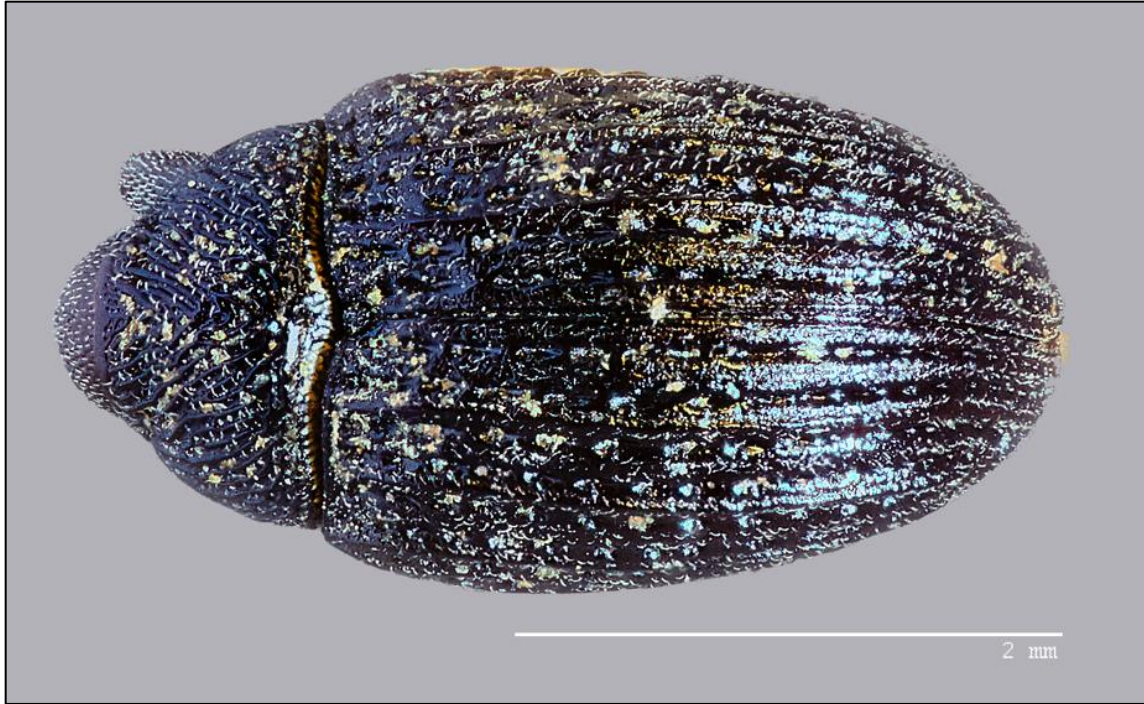


FIGURE 27: *Rhyssomatus aequalis* dorsal image.



FIGURE 28: *Rhyssomatus aequalis* lateral image.



FIGURE 29: *Rhyssomatus aequalis* frontal image.

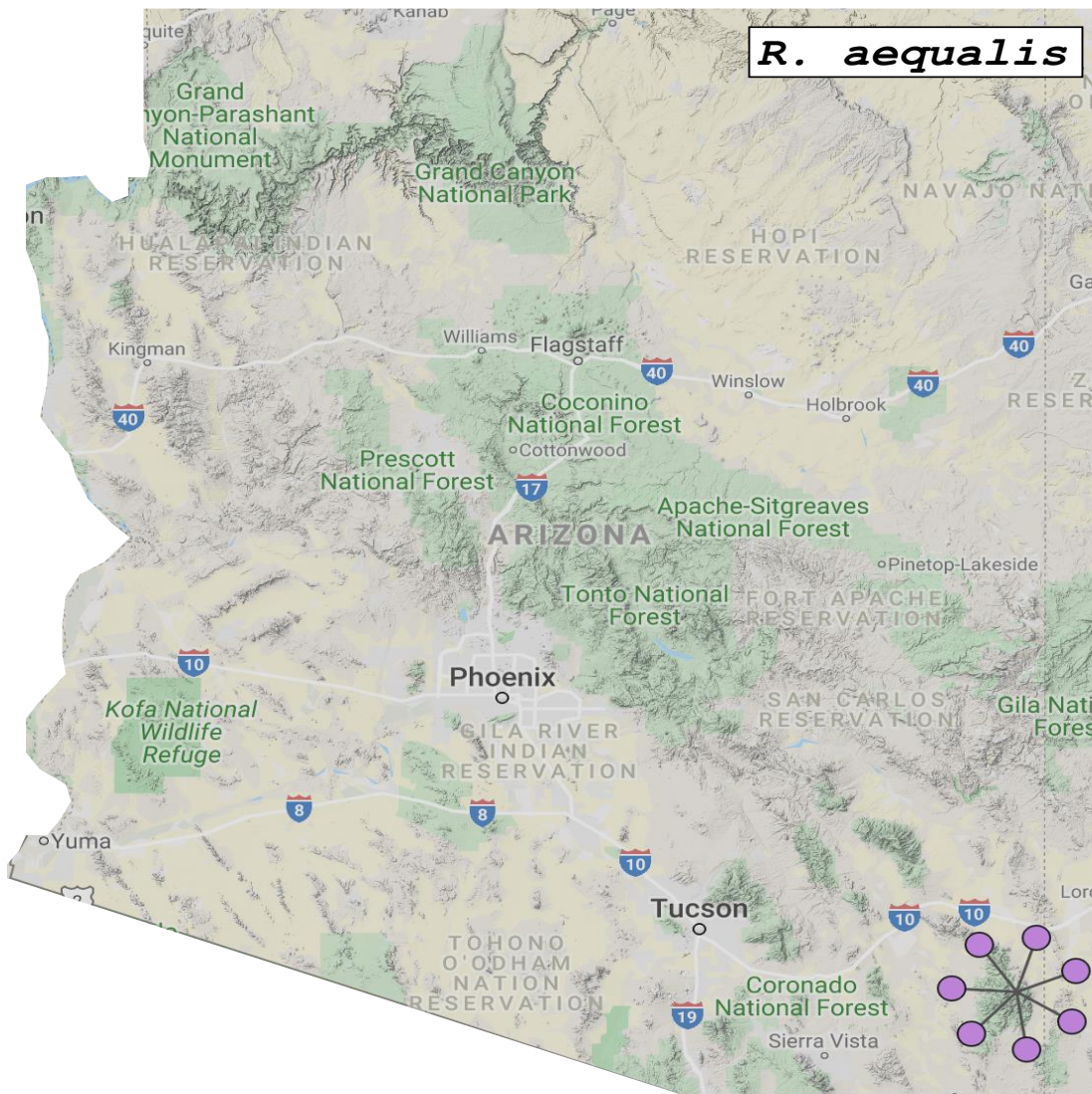


FIGURE 30: *Rhyssomatus aequalis* distributional map of Arizona; sourced from Ecdysis: A portal for love-data arthropod collections.

Rhyssomatus arizonicus Van Dyke, 1930

= *Rhyssomatus arizonicus* [Van Dyke 1930:162]

Holotype. California Academy of Sciences (CAS); USA, California, San Francisco
(No.2647)

Paratype from Prescott, Arizona, collected August 13, 1909 and June 20 1909, by Mr. J.A. Kusche, and two paratypes from Dewey, Arizona, in Van Dykes Collection (Van Dyke, 1930).

Diagnosis. *Rhyssomatus arizonicus* is most likely to be confused with *Rhyssomatus lineaticollis* (Say, 1824) Determination of the two species is best done by examining the elytral humeri which in *R. lineaticollis* is prominent, producing a distinct bulge in dorsal profile. In *R. arizonicus* the elytral humeri is present but feeble, with the lateral margins of the prothorax more oblique and almost continuous with the lateral margins of the elytra in dorsal view. Van Dyke (1930) states in the original description that, in side-by-side comparison, *R. arizonicus* has “dorsal crista better defined, the elytra distinctly rugose and shining, not minutely granular and sub-opaque, and by having a fine though sparse pubescence.” There is no specification as to whether he is referring to the “dorsal crista” on the pronotum or elytra, however after examining numerous specimens I believe this character to be invalid as the “dorsal crista” on both the pronotum and elytra are too similar in both species. I believe this distinction, in part, is due to *R. arizonicus* possessing a more “shining” appearance than *R. lineaticollis*, and therefore the crista

appear more defined; *R. arizonicus* also tends to have more pubescence, sparsely covering entire body.

Redescription

Habitus. Male: Length 6.86-7.09 mm, width 3.74-3.80 mm, length/width ratio 1.83-1.86 (N=2). *Female:* Length 7.07-7.19 mm, width 3.68-3.70 mm, length/width ratio 1.91-1.95 (N=2). Body oval from dorsal view. Integument black overall with antennae rubescent and tarsi aenesent. Ventral portion of body closely punctate with 5th abdominal ventral sclerite densely punctate. Feeble humeri curves and tapers quickly anteriorly before pronotum giving a cinched appearance. Alternate intervals of elytra carinate, shallow depressions (fovaea) are found at interstria's 3, 5, 7, 9 from the base to the apex, 8 and 10 at the base; fovea with lateral, evenly spaced punctures. Aforementioned interstices 3, 5, 7, 9 sharply costate, remaining interstices relatively smooth.

Head. Eyes narrowly separated (approximately the width of 6-8 facets), eyes recessed, slightly laterally compressed, medially tapering to a blunt angle, distal portion wide and continuous to pronotum with short yellowish setae surrounding perimeter of entire eye. Head closely punctate with short yellow setae arising from center of each puncture.

Antennae. Scrobe laterally descending, antennal scape inserted 1/3 from distal apex of rostrum. Funicle with 7 flagellomeres, club ovoid in shape, compressed. Flagellomeres and club densely setaceous, scape with sparse setae.

Mandibles. Decussate and bifurcated.

Rostrum. **Males:** Length 2.07-3.00 mm, rostrum/pronotum length ratio 1.21-1.53, rostrum length/width ratio 3.83-4.56. **Female:** Length 2.09-2.23mm, rostrum/pronotum length ratio 1.91-1.95, rostrum length/width ratio 3.78-4.45. Rostrum slightly curved ventrally, basal half continuous with frons, not depressed. Rostrum with sharply defined medial carina that extends between the eyes before bifurcating slightly, flanked laterally by multiple carina at basal half; all carina taper 1/4 from distal apex. Sulca created by carina densely punctured at basal half, apex of rostrum sparsely punctate.

Pronotum. **Male:** Pronotum length/width ratio 0.56-0.63, pronotum/elytra length (not including elytral curvature) ratio 0.41-1.00. **Female:** Pronotum length/width ratio 0.52-1.03, pronotum/elytra length (not including elytral curvature) ratio 0.32-0.54. Pronotum twice as wide at base; from dorsal view distinctly curved, tapering slowly towards apex; lack setae. Apex gently indented around margin of head. Entire pronotum obliquely corrugated (especially on anterior and lateral segments). Possess slight but distinct median crista.

Scutellum. Scutellum circular to slightly subtriangular, punctate; recessed into elytra.

Legs. **Male:** Profemur/pronotum length ratio 1.12-1.46; protibia/profemur length ratio 0.74-0.76. **Female:** Profemur/pronotum length ratio 0.56-1.36; protibia/profemur length ratio 0.74-0.99. All femurs with distinct anteromesal tooth present. Meso- and metatibia with no teeth, slightly curved. Femur and tibia sparsely punctate and sparsely covered in short to medium yellow setae.

Elytra. **Male:** Elytra length/width ratio 0.92-2.6. **Female:** Elytra length/width ratio 2.52-2.7. Shape sub triangulate in dorsal view, lateral margins gradually narrowed towards

blunt posterior apex. Alternate intervals of elytra carinate, shallow depressions (fovaea) are found at interstices 3, 5, 7, 9 from the base to the apex, 8 and 10 at the base; fovea with lateral, evenly spaced punctures. Aforementioned interstices 3, 5, 7, 9 sharply costate, remaining interstices relatively smooth. Feeble humeri, with the sides of the prothorax and elytra almost straight.

Terminalia. **Male:** Terminalia with tegmen similar to slightly longer in length to median lobe. Aedeagus lateral margins with slight declivity before converging at the basiventral margin, basiventral margin widely emarginate, lobe-like projections subtriangular. Lateral margins nearly straight and roundly/bluntly converging towards apex. **Female:** Apex of sternite 8 with distinct paddle-like flange on apical branches. Lateral margins of stem suddenly curve outwards posteriorly, giving base a fan-like appearance.

Etymology. The Latin term *arizonicus* is no doubt attributed to the original localities of all type specimens being from Arizona.

Material Examined.

ARTSYS0008444 - ARTSYS0008447; ARTSYS0008449 - ARTSYS0008450;

ARTSYS0008506; ARTSYS0008768 - ARTSYS0008771.

ASUCOB0008406; ASUCOB0008473 - ASUCOB0008474.

Habitat Range. United States: Arizona, Kansas, Texas.

Rhyssomatus arizonicus Van Dyke, 1930

Male: ARTSYS0008449

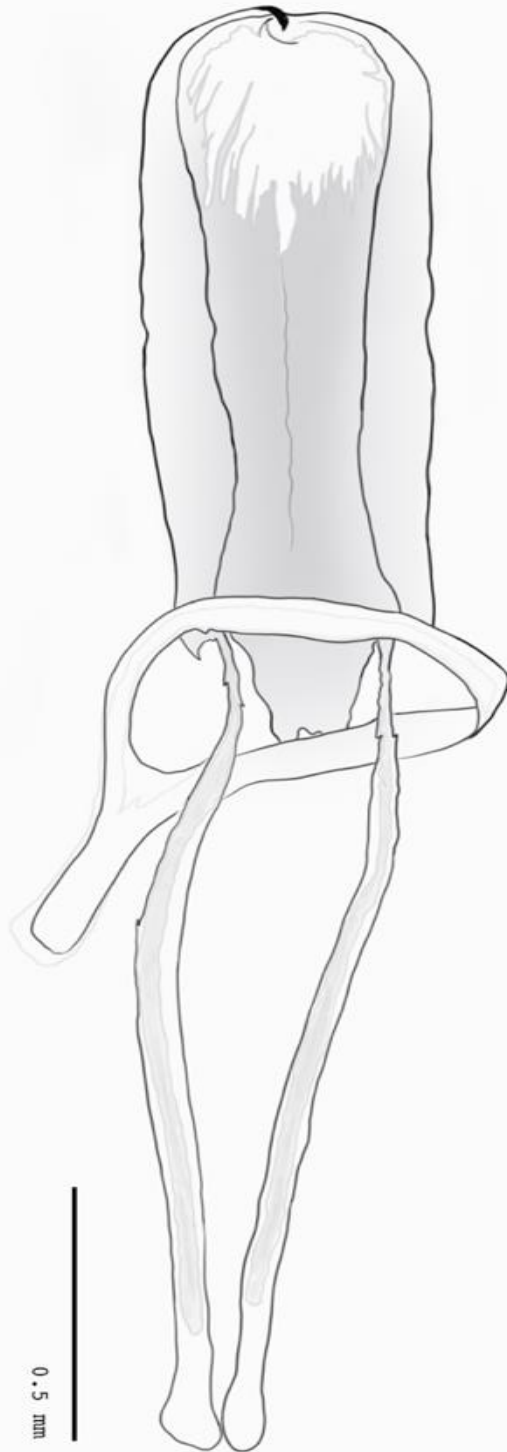


FIGURE 31: *Rhyssomatus arizonicus* male genitalia.

Rhyssomatus arizonicus Van Dyke, 1930

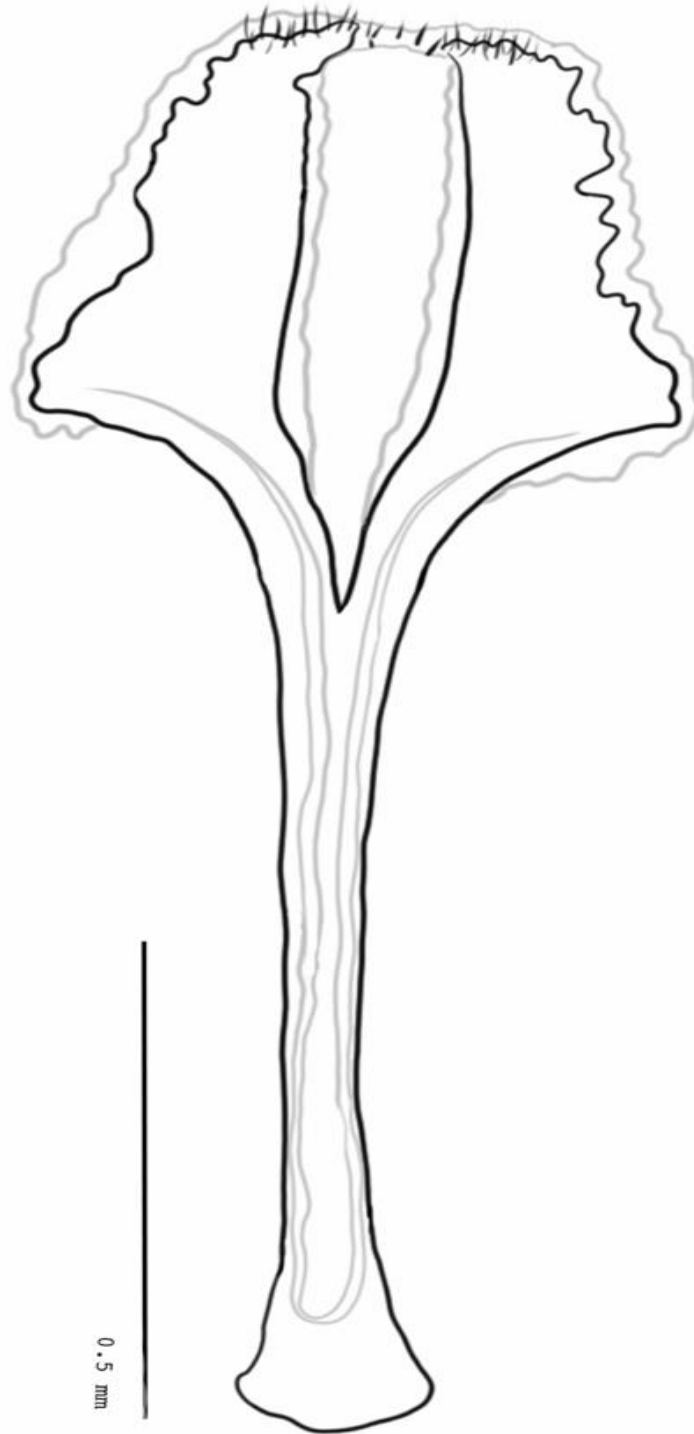


FIGURE 31: *Rhyssomatus arizonicus* female genitalia.



FIGURE 32: *Rhyssomatus arizonicus* dorsal image.



FIGURE 33: *Rhyssomatus arizonicus* lateral image.



FIGURE 34: *Rhyssomatus arizonicus* frontal image.

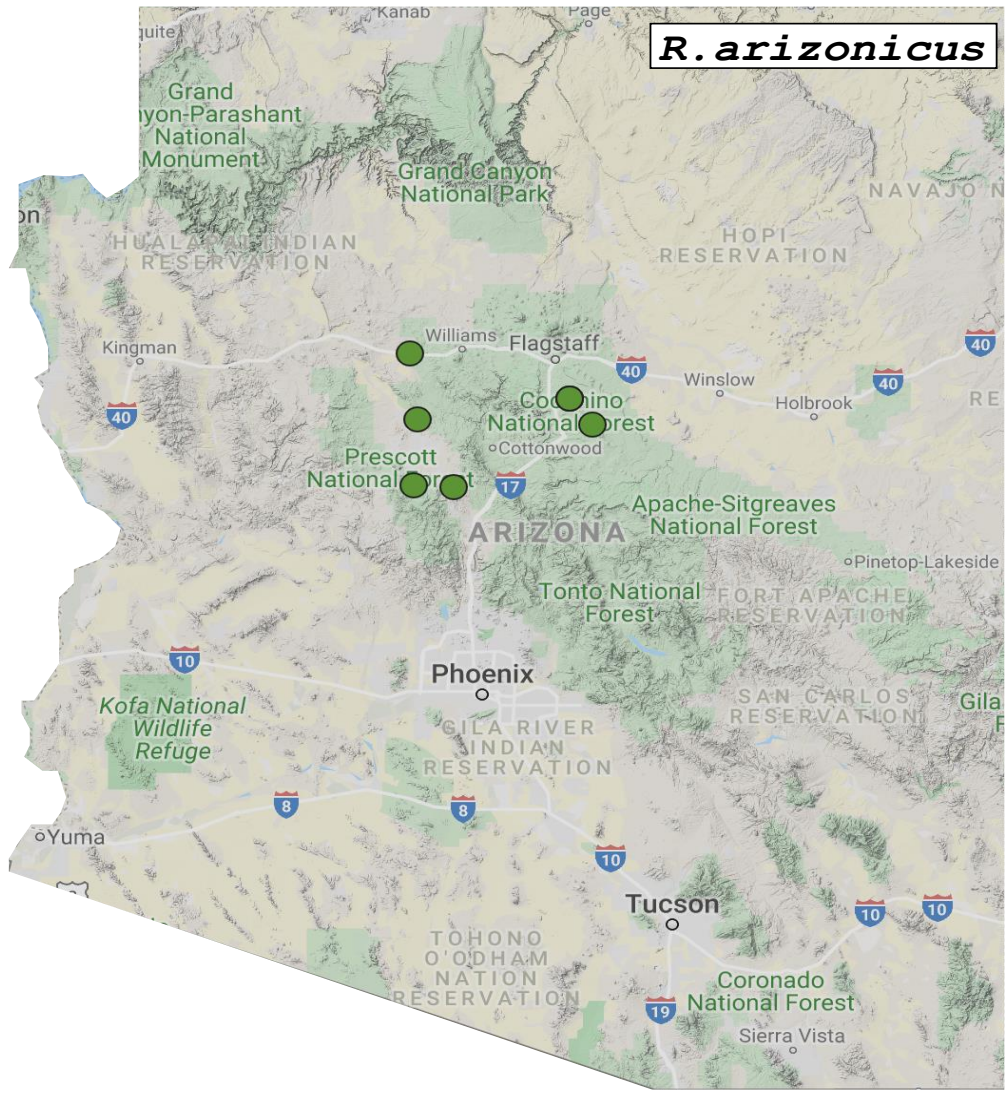


FIGURE 35: *Rhyssomatus arizonicus* distributional map of Arizona; sourced from Ecdysis Portal. 2023.

Rhyssomatus lineaticollis (Say, 1824)

= *Rhyssomatus lineaticollis* [Snow 1877:69], [Austin 1880:50], [Beutenmuller 1891:48], [Doane 1908:392], [Osborn 1910:71], [Leng 1910:79], [Pierce 1916:9], [Blatchley 1916:483], [Hayes 1919:211], [Weiss & Dickerson 1921:127], [Manee 1923:42], [Weiss, Coraci & McCoy 1941:156], [Betz 1989:189], [Hahn & Maron 2018:49]

= *Ryssematus lineaticollis* [Webster 1889:112], [Casey 1895:832]

= *Rynchaenus lineaticollis* [Say 1824:313]

Holotype. Harvard Museum of Comparative Zoology (MCZ); USA, Massachusetts, Cambridge. Arkansa (Say 1824:313)

Diagnosis. *Rhyssomatus lineaticollis* is the most studied North American species of the genus. Similar to *Rhyssomatus arizonicus* Van Dyke, 1930 (see **Diagnosis** of *R. arizonicus*), *Rhyssomatus palmacollis* (Say, 1831), *R. rugulipennis* Champion, 1904. *R. lineaticollis* can be distinguished from *R. palmacollis* by the acute medial carina on the basal half of the rostrum which abruptly splits into a fork between the eyes before ending; pronotum nearly twice as wide as long; scutellum glabrous or nearly so with sparse setae on lateral margin; elytra without tawny pubescent patches. *Rhyssomatus lineaticollis* can be distinguished from *R. rugulipennis* by being less pubescent; having a prominent and distinct humeri elytra striae within elytral interstices relatively shallow, not setigerous.

Redescription.

Habitus. **Male:** Length 5.07-7.15 mm, width 2.80-3.88 mm, length/width ratio 1.79-1.88, elytra length/width ratio 2.51-2.67 (N=5). **Female:** Length 5.29-6.58 mm, width 2.83-3.69 mm, length/width ratio 1.74-1.87, elytra length/width ratio 2.28-2.69 (N=6). Body oval from dorsal view. Integument black overall with antennae and tarsi rubescent.

Prominent humeri curves and tapers quickly anteriorly before pronotum, giving a cinched appearance. Alternate intervals of elytra carinate, shallow depressions (fovaea) are found at interstices 3, 5, 7, 9 from the base to the apex, 8 and 10 at the base; fovea with lateral, evenly spaced punctures. Aforementioned interstices 3, 5, 7, 9 sharply costate, remaining interstices relatively smooth.

Head. Eyes narrowly separated (approximately the width of 4-5 facets), eyes recessed, slightly laterally compressed, medially tapering to a blunt angle, distal portion wide and continuous to pronotum. Head covered with short, robust yellow setae.

Antennae. Scrobe laterally descending, antennal scape inserted 1/3 from distal apex of rostrum. Funicle with 8 flagellomeres, club ovoid in shape, compressed. Flagellomeres and club densely setaceous (reddish brown setae), scape with sparse setae.

Mandibles. Decussate and bifurcated.

Rostrum. **Males:** Length 2.07-3.00 mm, rostrum/pronotum length ratio 1.21-1.53, rostrum length/width ratio 3.83-4.56. **Female:** Length 2.09-2.23mm, rostrum/pronotum length ratio 1.91-1.95, rostrum length/width ratio 3.78-4.45. Rostrum slightly curved ventrally, basal half continuous with frons, not depressed. Rostrum with sharply defined medial carina that extends between the eyes before bifurcating slightly, flanked laterally by

multiple carina at basal half; all carina taper 1/4 from distal apex. Basal portion of rostrum with sparse yellow setae.

Pronotum. **Male**: Pronotum length/width ratio 0.56-0.63, pronotum/elytra length (not including elytral curvature) ratio 0.41-1.00. **Female**: Pronotum length/width ratio 0.52-1.03, pronotum/elytra length (not including elytral curvature) ratio 0.32-0.54. Pronotum twice as wide at base; from dorsal view distinctly curved, tapering slowly towards apex. Apex gently indented around margin of head, creating a apical constriction of the pronotum.

Scutellum. Round to heart-shaped; glabrous, if setae present, they are fine and surround the outer margins.

Legs. **Male**: Profemur/pronotum length ratio 1.12-1.46; protibia/profemur length ratio 0.74-0.76. **Female**: Profemur/pronotum length ratio 0.56-1.36; protibia/profemur length ratio 0.74-0.99. Meso- and metafemurs with distinct anteromesal tooth present. Meso- and metatibia slightly curved. Femur and tibia sparsely punctate and sparsely covered in short to medium yellow setae.

Elytra. **Male**: Elytra length/width ratio 0.92-2.6. **Female**: Elytra length/width ratio 2.52-2.7. Similar to *Rhyssomatus arizonicus*. Shape sub triangulate in dorsal view, lateral margins gradually narrowed towards blunt posterior apex. Alternate intervals of elytra carinate, shallow depressions (fovaea) are found at interstices 3, 5, 7, 9 from the base to the apex, 8 and 10 at the base; fovea with lateral, evenly spaced punctures.

Aforementioned interstices 3, 5, 7, 9 sharply costate, remaining interstices relatively

smooth. Prominent humeri, creating distinct bulge in the dorsal profile of the sides of the elytra. If present, setae is miniscule and contained within elytral fovea.

Terminalia. **Male:** Terminalia with tegmen similar to slightly longer in length to median lobe. Aedeagus lateral margins with slight declivity before converging at the basiventral margin, basiventral margin widely emarginate, lobe-like projections subrounded. Lateral margins nearly straight and roundly/bluntly converging towards apex. **Female:** Apex of sternite 8 with fan-like flanges along entirety (i.e., branches), distal apex of stem fan-like with no flanges. Stem approximately same save as apical branches. Apex of sternite 8 possess short to medium setae.

Etymology. The name *lineaticollis* is a derivative of two different Latin roots; “*linea*” meaning ‘line’ and “*collis*” meaning ‘hill’. The name refers to the pronotum, with its *gyri*-like appearance.

Natural history.

By far the most documented *Rhyssomatus* endemic to North American, *Rhyssomatus lineaticollis* has a detailed documented natural history.

The species is commonly referred to as the milkweed stem borer and has been documented on *Asclepias amplexicaulis*, *A. exaltata*, *A. incarnata*, *A. latiflora*, *A. meadii*, *A. quadrifolia*, *A. syrica*, *A. tuberosa*, *A. verticillata*, and *A. viridiflora* with adults most commonly found on *Asclepias syrica* and *A. exaltata* (Betz, 1989; Betz, Rommel, and Ditchtl, 1997; Chaplin and Walker, 1982; Osborn, 1910; Pierce, 1916; Price and Wilson,

1979; Wilbur, 1976). Although univoltine populations may exist, the species is generally considered bivoltine with the first brood population emerges from mid May to August with peak emergence in June and the second brood emerging from early September to November (Betz, Rommel, and Ditchtl, 1997; Fordyce & Malcolm, 2000; Pierre and Hendrix, 2003). Feeding and ovipositioning behavior of the species differs in the literature with the majority of sources stating the stem (Betz, Rommel, and Ditchtl, 1997; Chaplin and Walker, 1982) to be the focus while others claim it is the milkweed pods (Franson and Willson, 1983; Pierre and Hendrix, 2003); this behavior may be dependent on the climate for any given year and availability of host plants. There can be up to 26 grubs in a stem according to Betz, Rommel, Ditchtl (1997) and they fill the pith with dark-blackish frass. For detailed descriptions of the egg, larva, and pupae reference Weiss and Dickerson (1921).

Adults are nocturnal, generally shallowly buried in the soil around the stem of the host; specimens observed active during the day generally hide under host plant leaves or within the milkweed flowers (Betz, Rommel, and Ditchtl, 1997). An interesting study done with the focus on *Rhyssomatus lineaticollis* found that unlike monarchs and other milkweed host specific insects, *Rhyssomatus* does not sequester the cardenolides from the plant to use in its own defense. Instead *Rhyssomatus* was found to avoid the latex latifer of milkweed by focusing on the stem and pith where the poison is not as abundant (Fordyce and Malcolm, 2000).

Although *Rhyssomatus lineaticollis* is not known to be as prolific of an agricultural pest as some other species in the genus, their widespread distribution allows for more work to be done on movement patterns. Generally speaking, it is assumed that other pest *Rhyssomatus* species, such as *R. niguerrimus* has similar distribution rates. According to a 2003 work done by Pierre and Hendrix *R. lineaticollis* is generally sedentary. Fifty percent of the recaptured beetles in the study had moved less than one meter from the original capture site. It is unknown if this is typical behavior or due to its preferred host, *Asclepias syriaca*, having such dense populations all over the United States as a result of the last 150 years of human disturbance and the plants weed-like tendencies.

Variation. *Rhyssomatus lineaticollis* can vary greatly throughout its large distributional range; the variations in question are usually in respect to general size, pubescence, and extent of corrugation of the pronotum.

Material Examined

ARTSYS0007955 - ARTSYS0008017; ARTSYS0008019 - ARTSYS0008023;

ARTSYS0008025 - ARTSYS0008047 - ARTSYS0008056; ARTSYS0008458 -

ARTSYS0008464; ARTSYS0008507; ARTSYS0008539 - ARTSYS0008571.

ASUCOB0008407; ASUCOB0008475 - ASUCOB0008523.

ASUHIC0127578 - ASUHIC0127581; ASUHIC0127639 - ASUHIC0127710.

FMNHINS4188173 - FMNHINS4188219.

INHS823256 - INHS823294.

LACM ENT 395059 - LACM ENT 395063.

MCZENT00682014 - MCZENT00682026.

Habitat Range. United States: Connecticut, District of Columbia, Illinois, Indiana, Massachusetts, Michigan, New Jersey, New York, Pennsylvania, Wisconsin, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Virginia, Texas, Utah, Iowa, Kansas, Minnesota, Missouri, North Dakota, Nebraska, South Dakota, Arizona, Colorado, Delaware, Maryland, Kentucky, Maine, Marshall Islands, Minnesota, New Hampshire, New Mexico, Ohio, Oklahoma, Vermont, West Virginia, Rhode Island; Canada: Manitoba, Ontario, Quebec, Ottawa.

Rhyssomatus lineaticollis (Say, 1824)



FIGURE 36: *Rhyssomatus lineaticollis* male genitalia.

Rhyssomatus lineaticollis (Say, 1824)

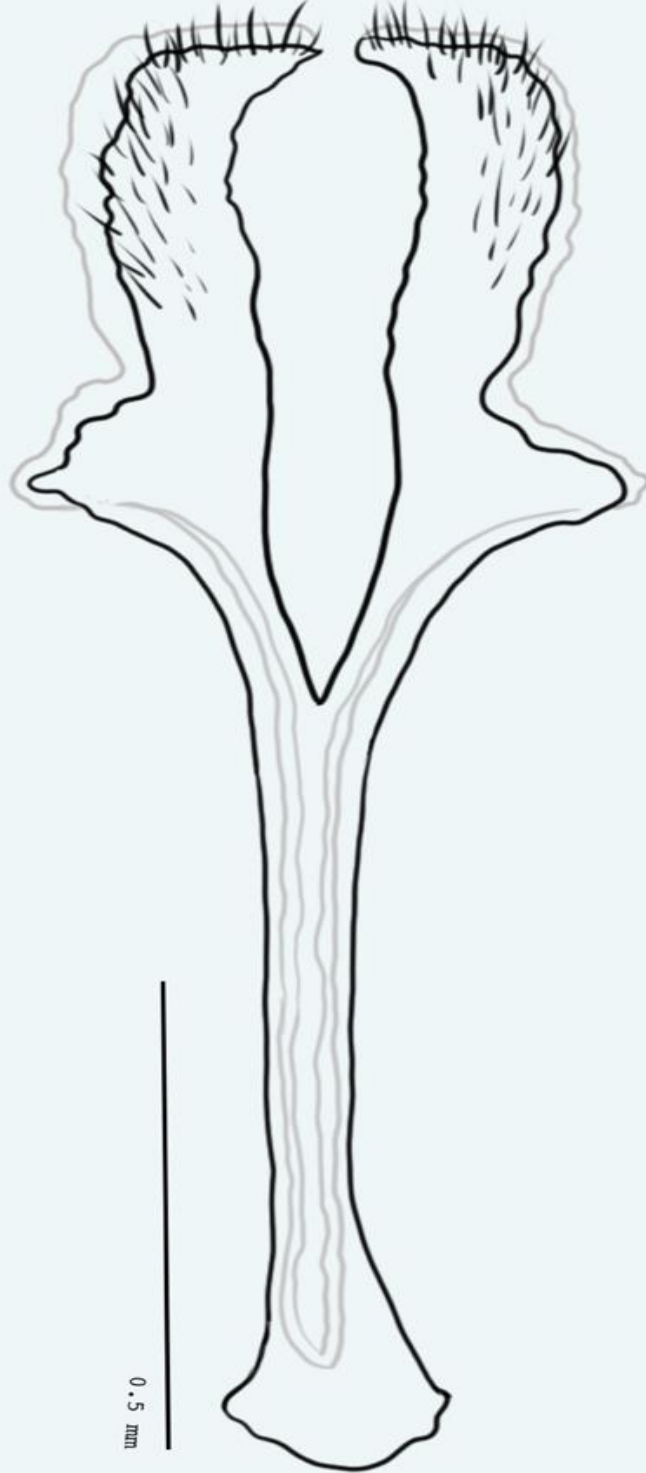


FIGURE 37: *Rhyssomatus lineaticollis* female genitalia.



FIGURE 38: *Rhyssomatus lineaticollis* dorsal image.



FIGURE 39: *Rhyssomatus lineaticollis* lateral image.



FIGURE 40: *Rhysomatus lineaticollis* frontal image.

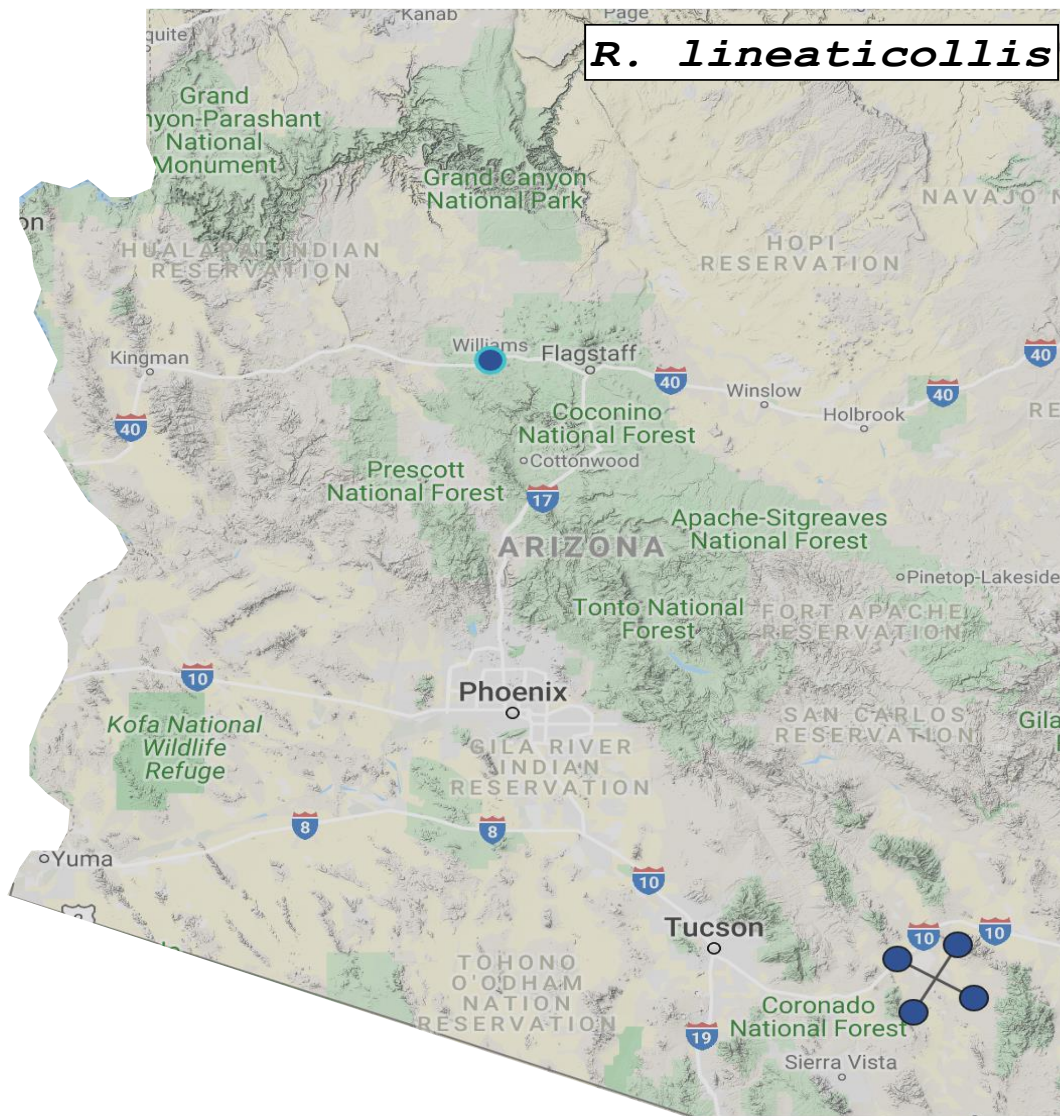


FIGURE 41: *Rhyssomatus lineaticollis* distributional map of Arizona; sourced from Ecdysis Portal. 2023.

Rhyssomatus medialis (Casey, 1895)

= *Ryssematus medialis* [Casey 1895:833]

Holotype. Smithsonian - The National Museum of Natural History (NMNH); USA, Washington, D.C. (Tucson). Mr. Wickham (Casey 1895:835)

Diagnosis. Within the Arizona species, *Rhyssomatus medialis* is most similar to *Rhyssomatus pubescens* Horn, 1873 and, in some cases, *Rhyssomatus palmacollis* (Say, 1831). *Rhyssomatus medialis* is distinguished from *R. pubescens* by its intermediate stria of elytra being feebly carinate as opposed to flat; long setae evenly distributed across pronotum and elytra (as opposed to sparse areas intermixed with denser patches); scutellum densely covered with tawny setae; eyes more approximate in comparison to *R. pubescens*. It can be readily distinguished from *R. palmacollis* due to *R. palmacollis*'s minuscule amount or lack of medium to long setae on ventral sclerites, intermediate stria of elytra being nearly flat as opposed to feebly carinate.

Redescription.

Habitus. **Male:** Length 4.11-4.56 mm, width 2.19-2.58 mm, length/width ratio 1.77-1.89 (N=3). **Female:** Length 4.23-5.65 mm, width 2.19-3.02 mm, length/width ratio 1.86-1.98 (N=5). Body subtriangular from dorsal view, tapering towards the apex. Integument rufus overall, with elytra and legs slightly darker; antennae rubescent. Body, including ventral sclerites, covered in medium to long yellow setae. Alternate intervals of elytral

stria (stria 1, 3, 5, 7, 9) carinate and sharply costate, remaining stria (stria 2, 4, 6, 8) carinate but not sharply so. Fovea between stria with lateral deep punctures from base to apex, minus between stria 7, 8, 9 where the stria join at the base of the elytra at one point.

Head. Eyes large, narrowly separated (approximately the width of approximately 2 facets); separated only by the medial carina. Ventral portion of the eyes under the rostrum nearly continuous. Recessed, slightly laterally compressed, medially tapering to a blunt angle anteriorly, posterior portion wide and continuous to pronotum; post ocular vibrissae present, very short. Head coarsely punctate with short yellow setae arising from center of each puncture, oriented downwards towards rostrum.

Antennae. Scrobe laterally descending, antennal scape inserted 1/3 from distal apex of rostrum; recessed in rostrum. Funicle with 8 flagellomeres, club ovoid in shape, compressed. Flagellomeres and club densely setaceous, said setae not repressed along flagellomeres. Scape either without setae or with sparse setae.

Mandibles. Decussate and bifurcated.

Rostrum. Males: Length 1.57-1.66 mm, rostrum/pronotum length ratio 1.46-1.73, rostrum length/width ratio 6.04-6.64. **Female:** Length 1.53-2.00 mm, rostrum/pronotum length ratio 0.61-1.68, rostrum length/width ratio 6.15-8.33. Rostrum approximately a third as long as body, robust, arcuate. Apex of rostrum with shallow punctures and minute yellow setae. From one-third of the rostrum to the base possess shallow lateral carinae; this area also possesses short yellow setae on lateral margins, sometimes medial margin. Base of rostrum with medium setae oriented proximally towards the eyes. Medial carina bifurcates into a wide 'V' shape over one-fourth of the apical, dorsal portion of the eyes.

Pronotum. **Male:** Pronotum length/width ratio 0.59-0.64, pronotum/elytra length (not including elytral curvature) ratio 0.31-0.35. **Female:** Pronotum length/width ratio 0.56-0.65, pronotum/elytra length (not including elytral curvature) ratio 0.29-0.35. Pronotum trapezoidal, possesses a medial carina. Covered in long yellow setae oriented towards medial carina. Integument feebly corrugated. Distinct anterior pronotal collar present.

Scutellum. Scutellum circular to slightly subtriangular. Densely covered in short yellow setae, recessed into elytra.

Legs. **Male:** Profemur/pronotum length ratio 1.13-1.30; protibia/profemur length ratio 0.79-0.81. **Female:** Profemur/pronotum length ratio 0.88-1.20; protibia/profemur length ratio 0.58-1.14. All femurs with distinct, small anteromesal tooth present. Femur and tibia sparsely punctate with short to medium yellow setae originating from each puncture.

Protibia with two anterior dorsal teeth in pincer-like form.

Elytra. **Male:** Elytra length/width ratio 2.46-2.89. **Female:** Elytra length/width ratio 2.5-2.81. Shape subtriangulate in dorsal view, lateral margins gradually narrowed towards blunt apex. Alternate intervals of elytral stria (stria 1, 3, 5, 7, 9) carinate and sharply costate, remaining stria (stria 2, 4, 6, 8) relatively smooth. Fovea between stria with lateral deep punctures from base to apex, minus between stria 7, 8, 9 where the stria join at the base of the elytra at one point. Humeri feebly distinct.

Terminalia. **Male:** Aedeagus lateral margins nearly straight before converging at the basiventral margin, basiventral margin widely rounded with a sharp median point.

Tegmen nearly twice as long as median lobe. **Female:** Sternite 8 with reduced fan-like flanges limited to base of the apical branches. Said flanges extend laterally in a sharp

triangular pattern, two thirds from the apex of the branches and then converging on the stem. Apex of apical branches with short, sparse setae. Stem of eternity 8 thin with straight lateral margins; base of stem possesses no flange.

Sexual Dimorphism. Metatibia anteriodorsal tooth present. Males sharp and complete, females reduced.

Etymology. The Latin term *medialis* translates to ‘middle’. The only mention of ‘middle’ in the original description is in terms of the origin of the antennae where Casey states “antennae inserted distinct behind the middle, the basal joint of the funicle as long as the next.”

Material Examined.

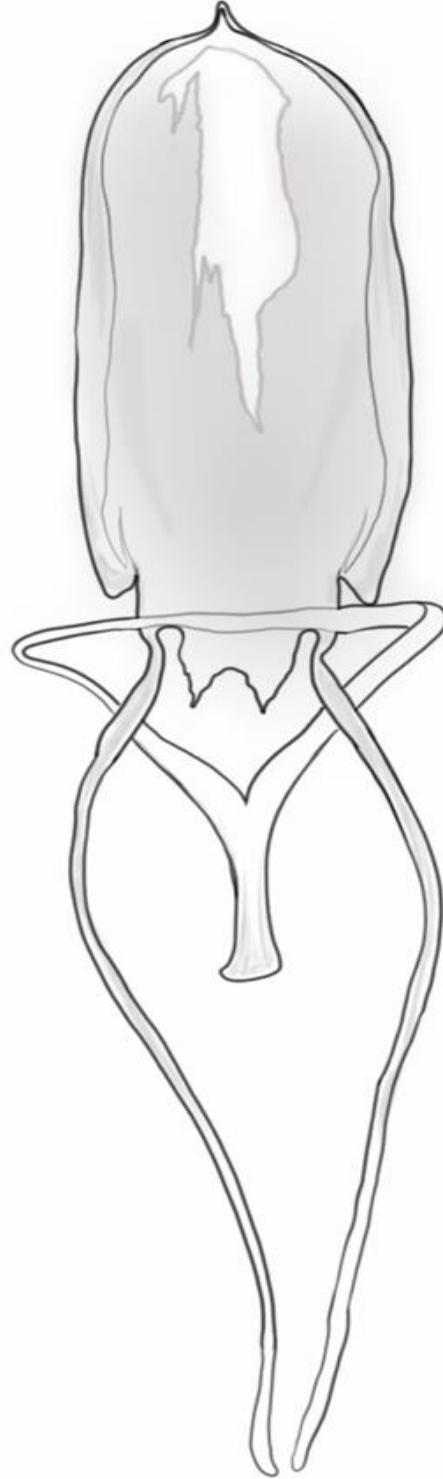
ARTSYS0008058 - ARTSYS0008059; ARTSYS0008070; ARTSYS0008465 -
ARTSYS0008774.

ASUCOB0008408; ASUCOB0008541 - ASUCOB0008572; ASUCOB0022894;
ASUHIC0127711.

FMNHINS4188221.

Habitat Range. United States: Arizona, New Mexico, Texas; Mexico: Sonora.

Rhyssomatus medialis (Casey, 1824)



0.5 mm

FIGURE 42: *Rhyssomatus medialis* male genitalia.

Rhyssomatus medialis (Casey, 1895)

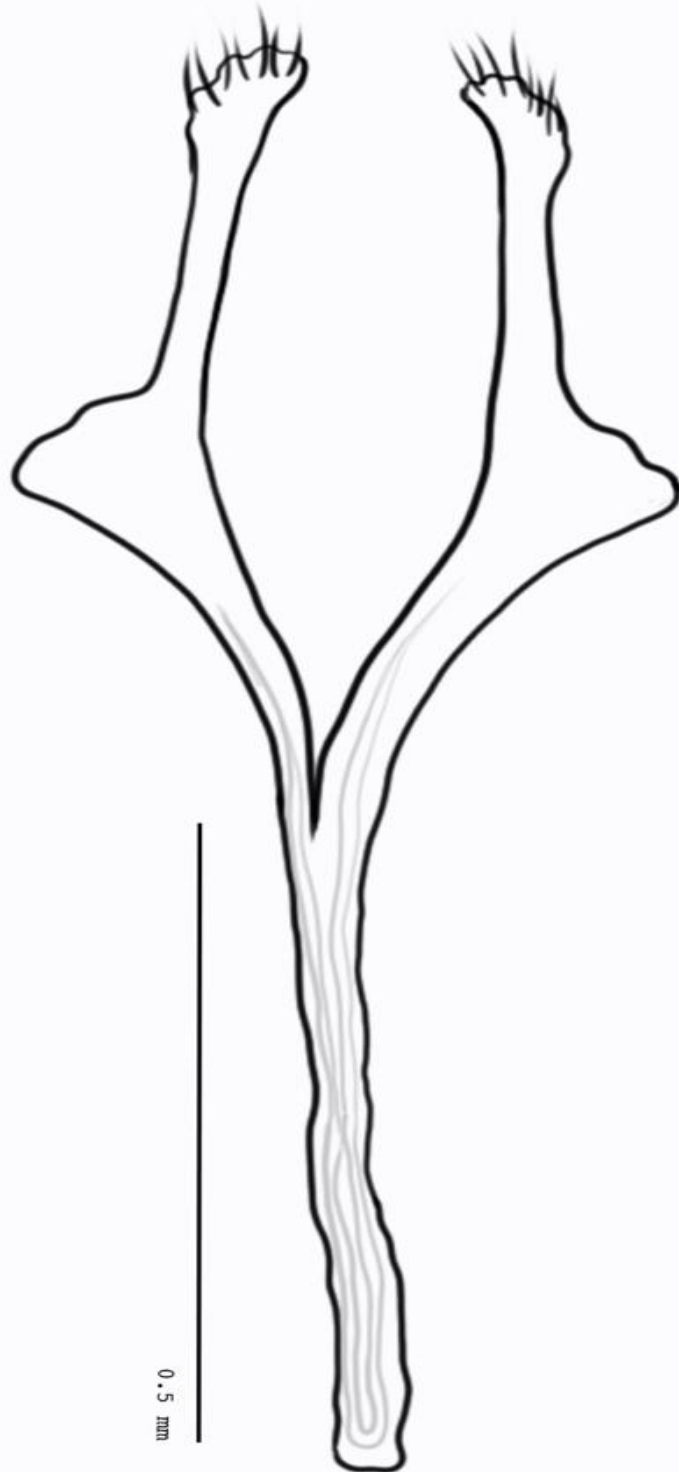


FIGURE 43: *Rhyssomatus medialis* female genitalia.



FIGURE 44: *Rhysomatus medialis* dorsal image.



FIGURE 45: *Rhyssomatus medialis* lateral image.



FIGURE 46: *Rhyssomatus medialis* frontal image.

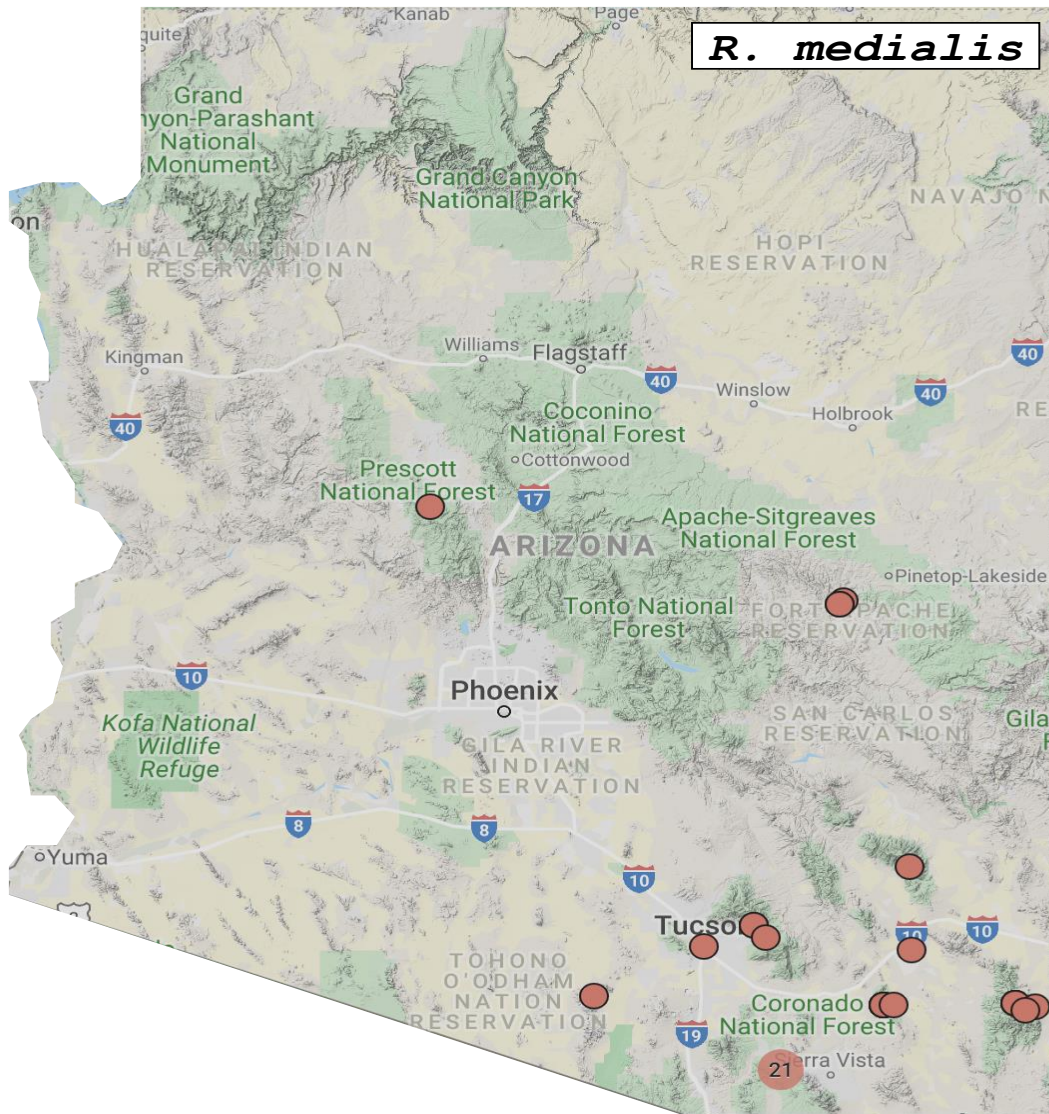


FIGURE 47: *Rhyssomatus medialis* distributional map of Arizona; sourced from Ecdysis Portal. 2023.

Rhyssomatus oculatus Schaeffer, 1909

= *Rhyssomatus oculatus* [Schaeffer 1909:386]

Holotype. Texas A&M University Insect Collection (TAMUIC); USA, Texas, College Station.

Nogales, Arizona (Schaeffer, 1909:386)

Diagnosis. *Rhyssomatus oculatus* is similar in form to *R. ovalis* Casey, 1892, *R. parvulus* Casey, 1895, and *R. pruinosus* (Boheman, 1845). However, the species is easily distinguishable by the alternate intervals of the elytra being carinate; all latter mentioned species belong to the Subgenus *Sermysatus* and therefore do not possess alternate carinate elytral intervals.

Redescription.

Habitus. **Male:** Length 4.57 mm, width 2.29 mm, length/width ratio 1.99 (N=1). **Female:** Length 2.15-2.30 mm, width 1.53-1.62 mm, length/width ratio 1.84-1.98 (N=3). Body oval from dorsal view with lateral margins nearly straight and converging rapidly at apex arcuately. Integument rufescent overall. Short, whitish setae present only on legs and abdomen. Ventral portion of body sparsely punctate. Humeri distinct. Alternate intervals of elytra distinctly carinate with shallow depressions (fovea) with coarse punctures. Aforementioned interstices sharply costate.

Head. Eyes widely separated (approximately the width of 8-11 facets), eyes recessed, slightly laterally compressed, medially tapering to a blunt angle, distal portion wide and continuous to pronotum. Possesses short yellow setae along posterior margin of the eye. Head covered in dense, shallow punctures.

Antennae. Scrobe laterally descending, antennal scape inserted 1/3 from distal apex of rostrum. Funicle with 8 flagellomeres, club oval in shape, compressed. Club densely setaceous.

Mandibles. Decussate and bifurcated.

Rostrum. **Males:** Length 1.6mm, rostrum/pronotum length ratio 1.29, rostrum length/width ratio 5.33. **Female:** Length 1.46-1.54 mm, rostrum/pronotum length ratio 1.25-1.48, rostrum length/width ratio 4.67-6.95. Rostrum slightly curved ventrally, basal half continuous with front, not depressed. Without medial carina, punctate along lateral margins, without lateral carina.

Pronotum. **Male:** Pronotum length/width ratio 0.74, pronotum/elytra length (not including elytral curvature) ratio 0.39. **Female:** Pronotum length/width ratio 0.68-0.75, pronotum/elytra length (not including elytral curvature) ratio 0.34-0.41. Pronotum sub trapezoidal with a slightly bulbous appearance. Dorsal surface densely punctate with lateral margins weakly obliquely corrugated; lacks setae. Apex gently indented around margin of head giving a slightly collared appearance.

Scutellum. Scutellum small, circular to ovate. Recessed into elytra, lacking setae.

Legs. **Male:** Profemur/pronotum length ratio 1.04; protibia/profemur length ratio 0.70.

Female: Profemur/pronotum length ratio 1.02-1.14; protibia/profemur length ratio 0.70-

0.74. All femurs with distinct anteromesal tooth present. Femur and tibia sparsely, irregularly punctate with thin, short to medium setae emerging from each puncture.

Elytra. Male: Elytra length/width ratio 2.67. **Female:** Elytra length/width ratio 2.57-2.91.

Lateral margins of elytra nearly lateral before tapering arcuately at apex. Humeri feeble, base of elytra almost flush with base of pronotum. Alternate elytral interstices carinate; fovea with lateral, evenly spaced punctures.

Terminalia. Male: Aedeagus distinct from other species. Lateral margins of median lobe straight and subtriangular at the apex; nearly 5 times as long to wide. Terminalia with tegmen similar in length to median lobe. **Female:** Apex of sternite 8 with bulbous projections, these projections possess long setae at apex. Lateral margins of sternite 8 gently curve outward toward base, no fan-like appearance as in *Rhyssomatus arizonicus*.

Etymology. Although the Latin term *oculatus* is usually attributed to ‘having eyes’ or ‘having the capability of seeing’ the word can also be used to describe something as ‘conspicuous’. In his original description, Schaeffer describes *R. oculatus* in these words “The pale color, the alternately carinate elytral intervals and the widely separated eyes make this an easily recognizable species.” Here the phrase “easily recognizable” can be understood as a synonym of ‘conspicuous’.

Material Examined.

ARTSYS0008500 - ARTSYS0008502; ARTSYS0008766 - ARTSYS0008767;

ARTSYS0011029 - ARTSYS0011042.

ASUCOB0008574 - ASUCOB0008585; ASUCOB0008587 - ASUCOB0008589.

ASUHIC0127712.

Habitat Range. United States: Arizona, Texas.

Rhyssomatus oculatus Schaeffer, 1909

Male: ASUCOB0008586

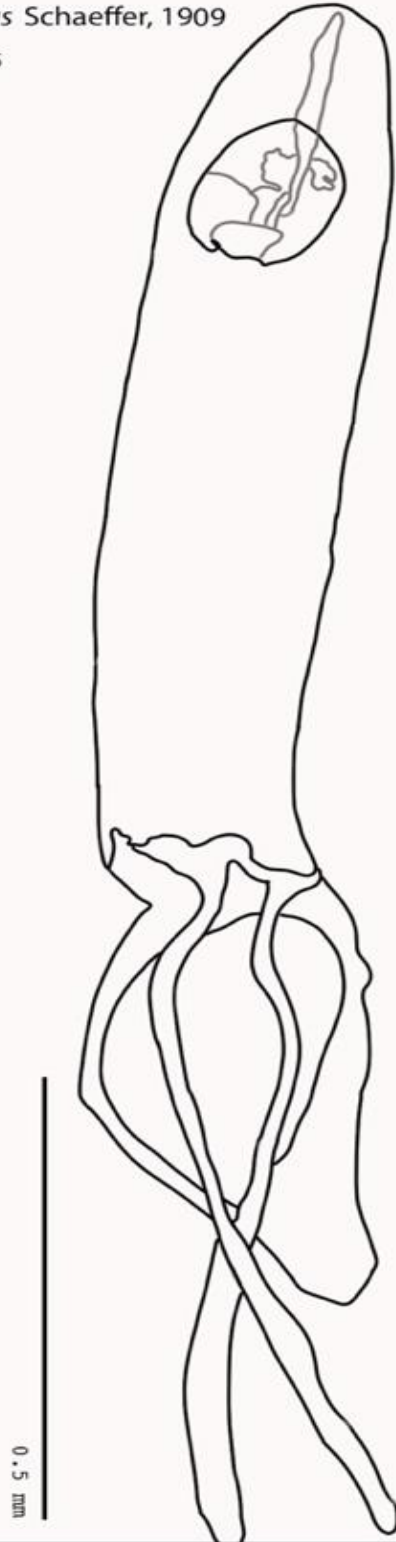


FIGURE 48: *Rhyssomatus oculatus* male genitalia.

Rhyssomatus oculatus Schaeffer, 1909

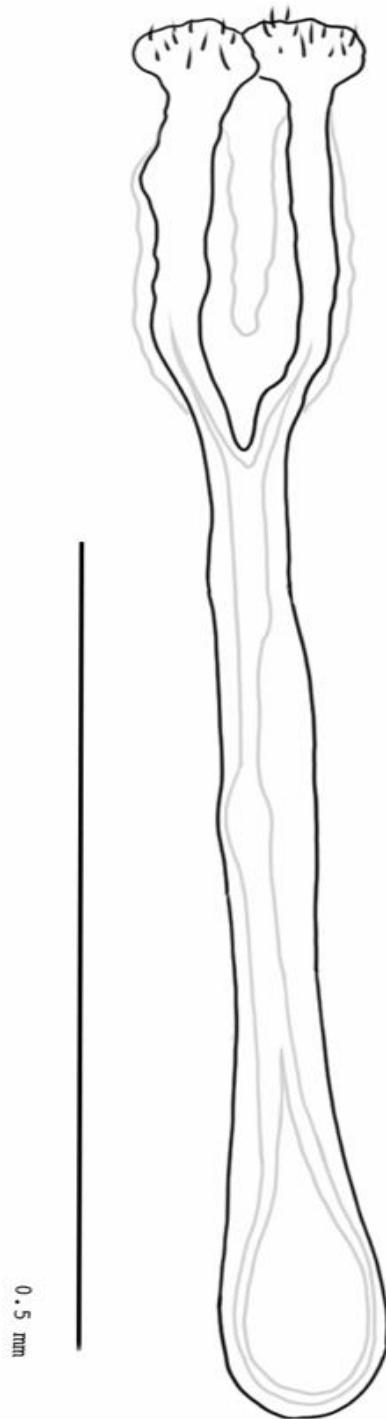


FIGURE 49: *Rhyssomatus oculatus* female genitalia.



FIGURE 50: *Rhyssomatus oculatus* dorsal image.



FIGURE 51: *Rhyssomatus oculatus* lateral image.



FIGURE 52: *Rhyssomatus oculatus* frontal image.

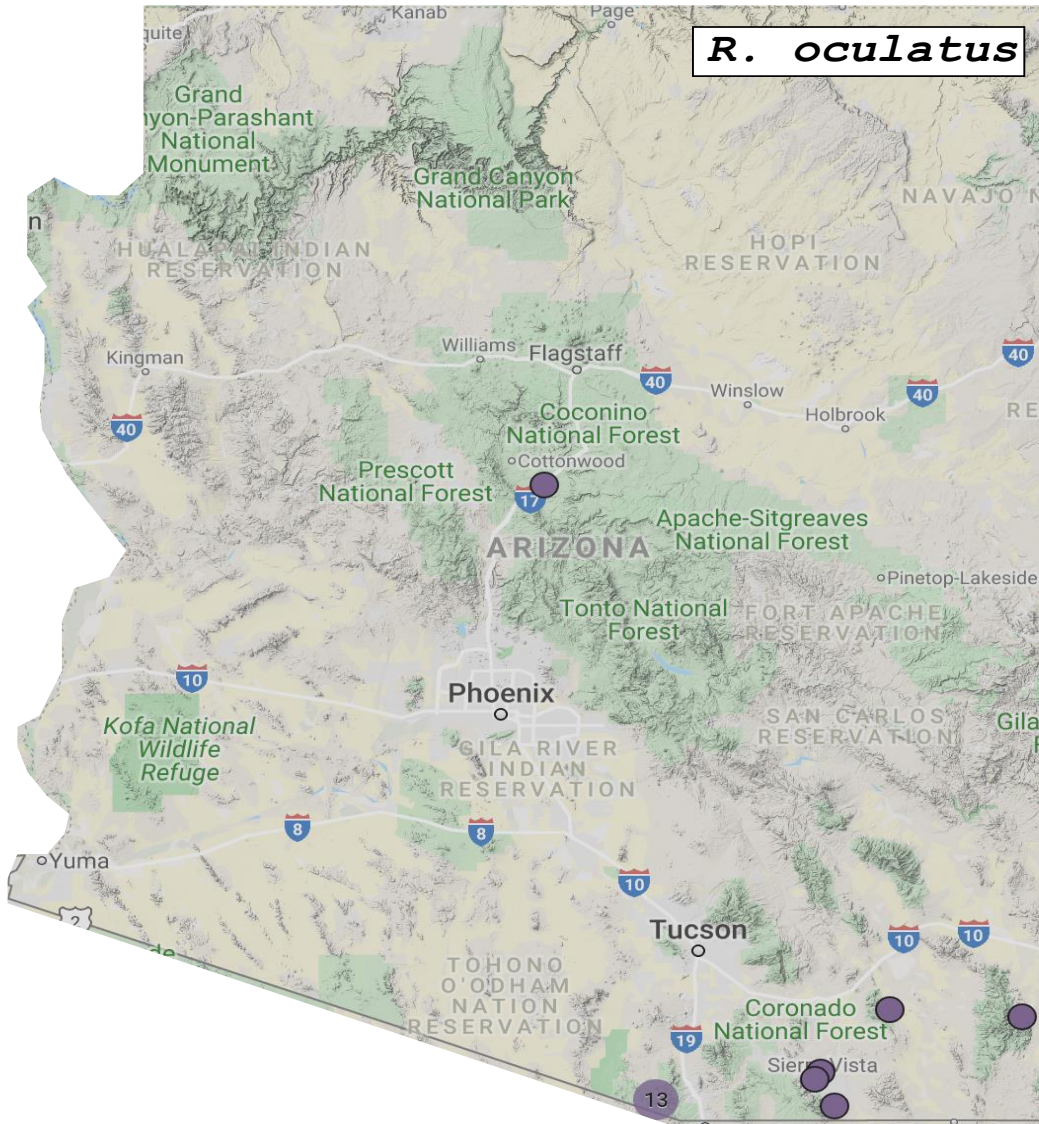


FIGURE 53: *Rhyssomatus oculatus* distributional map of Arizona; sourced from Ecdysis Portal. 2023.

Rhyssomatus ovalis (Casey, 1892)

= *Ryssematus ovalis* [Casey 1892:443]

Holotype. Smithsonian - The National Museum of Natural History (NMNH); USA, Washington, D.C. Texas (Casey 1892:444)

Diagnosis. When considering only Arizona occurring species, *Rhyssomatus ovalis* is most similar in form to *R. oculatus* Schaffer, 1909, *R. parvulus* Casey, 1895, and *R. pruinosus* (Boheman, 1895). From *R. oculatus* it is easily distinguishable by having alternate intervals of the elytra not carinate (character distinguishing *R. ovalis* within *Sermysatus*). Both *Rhyssomatus parvulus* and *pruinosus*, also possess non-carinate alternate elytral intervals, therefore this character cannot be used. *R. parvulus* can be distinguished by its distinctly punctate abdomen and slight divet located medially in apical pronotal collar. Easily distinguished from *R. pruinosus* by possessing widely separated eyes, stouter rostrum, and large post ocular lobe.

Redescription

Habitus. **Male:** Length 3.21mm, width 1.76mm, length/width ratio 1.82 (N=1). **Female:** Length 3.41-4.57mm, width 1.8-2.39mm, length/width ratio 1.89-1.99 (N=3). As the name suggests the overall form of this species is oval from dorsal view. Integument rufus. Possessing short, yellow setae only on the legs; rest of body glabrous. Ventral portion of body closely punctate with 5th abdominal ventral sclerite possessing medial divit. Humeri

feeble, nearly continuous with pronotum. Alternate intervals of elytra non-carinate, instead possessing lateral rows of evenly spaced shallow depressions (character placing this species in the subgenus *Sermysatus*).

Head. Eyes slightly variable, usually widely separated (approximately the width of 8-9 facets), eyes recessed, slightly laterally compressed, medially tapering to a blunt angle, distal portion wide and continuous to pronotum with short yellowish setae surrounding perimeter of entire eye. Post ocular lobe well defined, covering the posterior portion of the eye. Head covered in shallow punctures.

Antennae. Scrobe laterally descending, antennal scape inserted 1/3 from distal apex of rostrum. Funicle with 7 flagellomeres, club ovoid in shape, compressed. Flagellomeres and club densely setaceous, scape with sparse setae.

Mandibles. Decussate and bifurcated.

Rostrum. **Males:** Length 1.27 mm, rostrum/pronotum length ratio 1.55, rostrum length/width ratio 5.52. **Female:** Length 1.12-1.33mm, rostrum/pronotum length ratio 0.93-1.56, rostrum length/width ratio 4.15-11.82. Rostrum slightly curved ventrally, basal half continuous with frons, not depressed. Lacking a medial carina, with shallow punctures throughout.

Pronotum. **Male:** Pronotum length/width ratio 0.64, pronotum/elytra length (not including elytral curvature) ratio 0.40. **Female:** Pronotum length/width ratio 0.64-0.67, pronotum/elytra length (not including elytral curvature) ratio 0.34-0.40. Pronotum twice as wide at base; from dorsal view distinctly curved, tapering slowly towards apex; lack setae. Apex gently indented around margin of head forming a distinct pronotal collar.

Possesses shallow punctures that move laterally from apex towards medial carina; medial carina not elevated, smooth.

Scutellum. Scutellum small and circular, nearly black. Not repressed into elytra.

Legs. Male: Profemur/pronotum length ratio 1.11; protibia/profemur length ratio 0.85.

Female: Profemur/pronotum length ratio 0.24-1.22; protibia/profemur length ratio 0.71-0.85. All femurs with distinct anteromesal tooth present. Femur and tibia sparsely punctate and sparsely covered in short yellow-white setae.

Elytra. Male: Elytra length/width ratio 2.40. **Female:** Elytra length/width ratio 2.77-2.85.

Shape oval in dorsal view. Lateral margins gradually narrowed towards blunt posterior apex. Alternate intervals of elytra non-carinate, instead possessing lateral rows of evenly spaced shallow depressions (character placing this species in the subgenus *Sermysatus*).

Terminalia. Male: Terminalia with tegmen similar to, slightly longer in length to median lobe. Lateral margins gently expanding outward until apex, end is roundly/bluntly.

Possess a distinct, curved, distally oriented flange at apex. **Female:** Sternite 8 with apical branches twice as long as stem. No flanges or fan-like structures present, long and thin overall. Apical branches forming a distinct “V” shape. Apex of branches with short, sparse setae.

Etymology. The Latin term *ovalis* means oval. This most likely refers to Casey’s original description in which he describes the species as “(e)venly oval.”

Material Examined.

ARTSYS0007913 - ARTSYS0007915; ARTSYS0007917; ARTSYS0007921 -
ARTSYS0007922; ARTSYS0007924; ARTSYS0007932 - ARTSYS0007945;
ARTSYS0007949 - ARTSYS0007950; ARTSYS0008477 - ARTSYS0008480;
ARTSYS0008488 - ARTSYS0008499.
ASUCOB0008591; ASUCOB0008593 - ASUCOB0008604.

Habitat Range. United States: Texas, Arizona, New Mexico; Mexico; Panama.

Rhyssomatus ovalis (Casey, 1892)

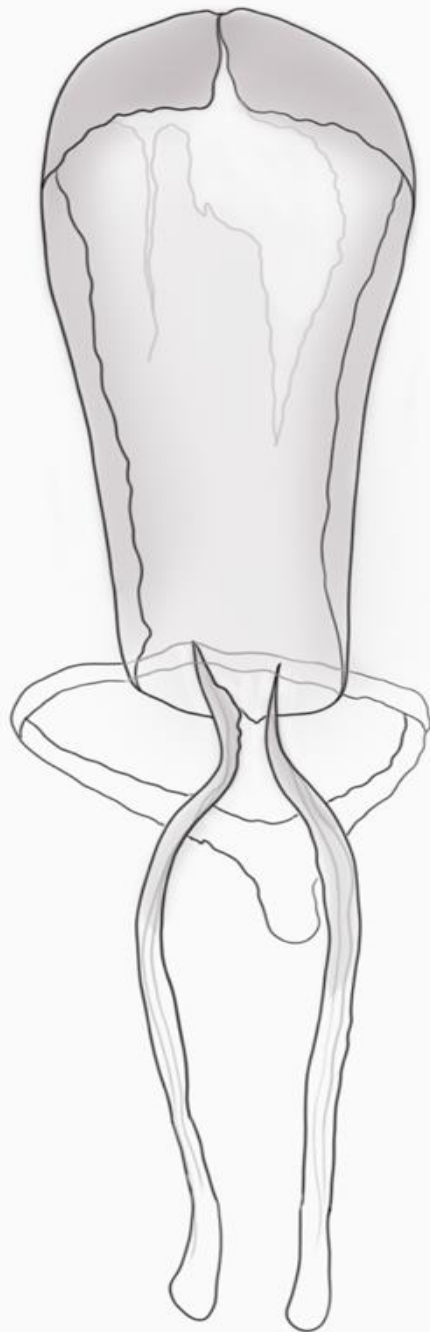


FIGURE 54: *Rhyssomatus ovalis* male genitalia.

Rhyssomatus ovalis (Casey, 1892)

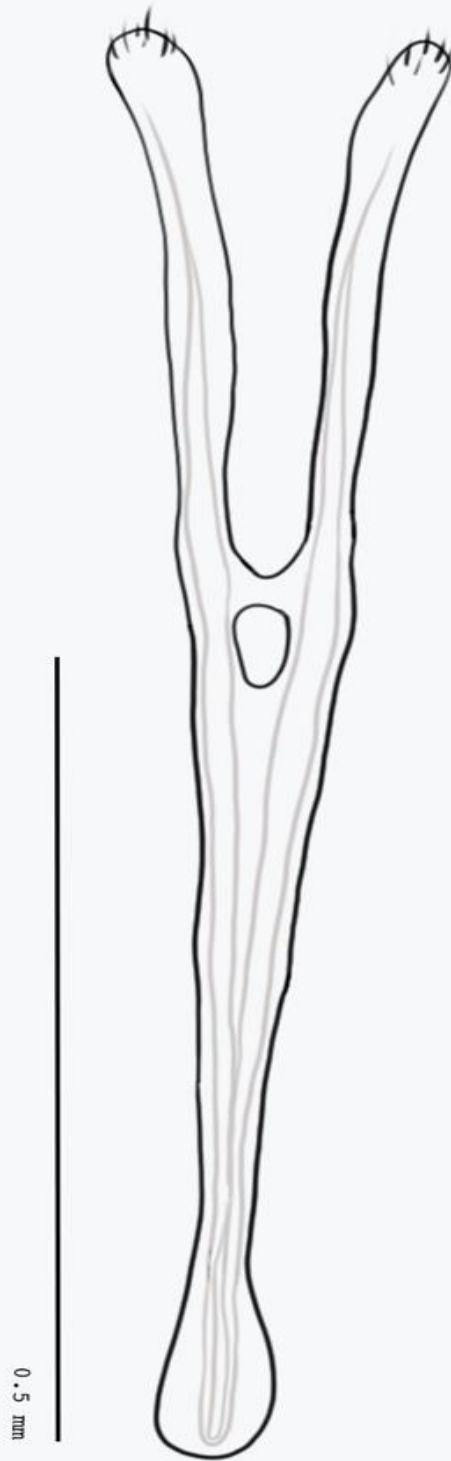


FIGURE 55: *Rhyssomatus ovalis* female genitalia.



FIGURE 56: *Rhyssomatus ovalis* dorsal image.



FIGURE 57: *Rhysomatus ovalis* lateral image.



FIGURE 58: *Rhyssomatus ovalis* frontal image.

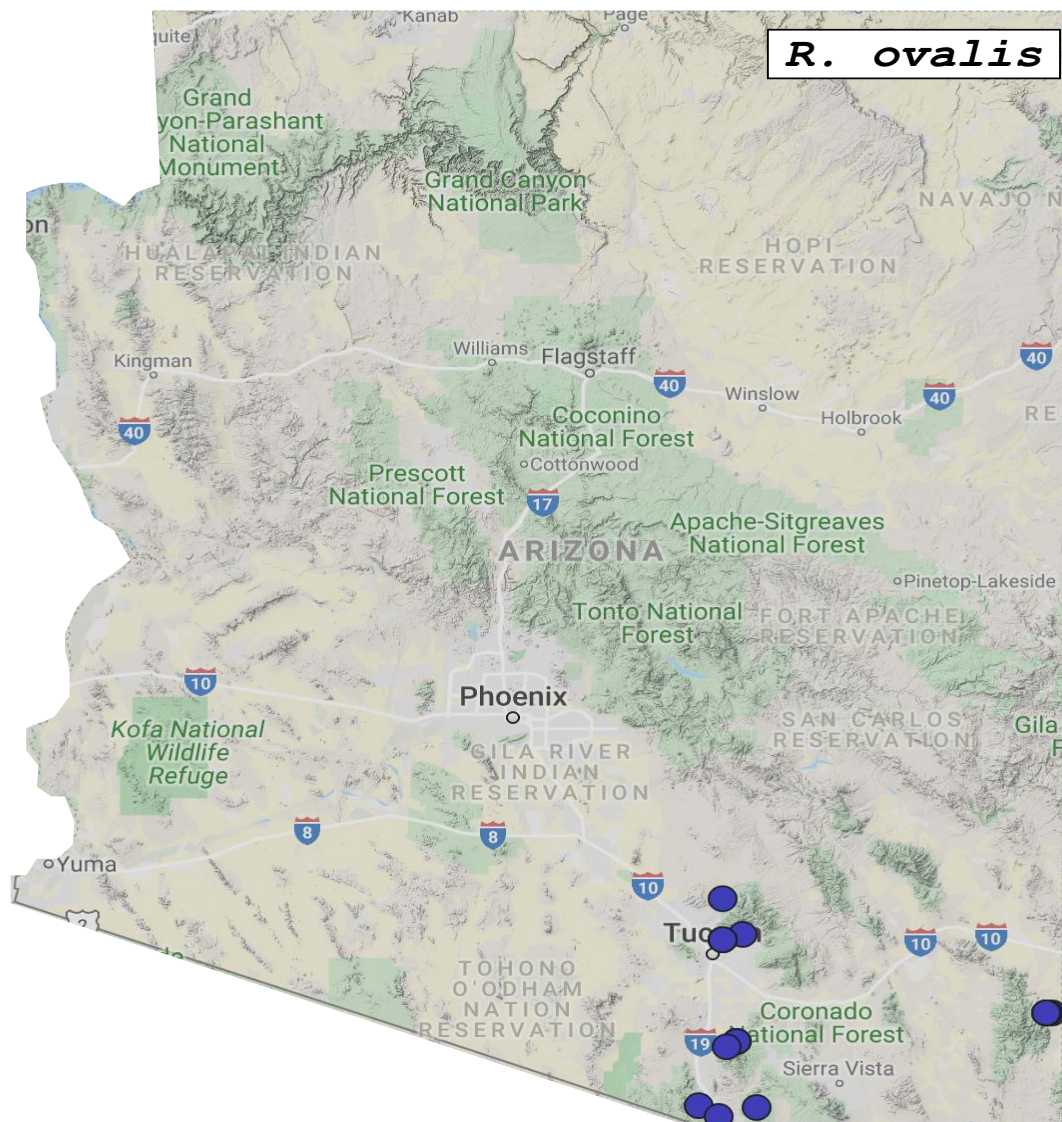


FIGURE 59: *Rhyssomatus ovalis* distributional map of Arizona; sourced from Ecdysis Portal. 2023.

Rhyssomatus palmacollis (Say, 1831)

= *Crytorhynchus palmacollis* [Say 1831:27]

= *Rhyssomatus palmacollis* [Popenoe 1877:85]; [Austin 1880:50]; [Riley 1889:112]; [Tucker 1905:88]; [Osborn 1910: 71]; [Hunter & Pierce 1912:30, 185-186]; [Pierce 1916:9]; [Blatchley & Leng 1916:483]; [Blatchley 1928:238]

= *Ryssematus palmacollis* [Casey 1895: 832]

= *Rhyssomatus palmicollis* [Hayes 1919:211]

Holotype. Harvard Museum of Comparative Zoology (MCZ); USA, Massachusetts, Cambridge. Mississippi (Say 1831:27)

Diagnosis. *Rhyssomatus palmacollis* is easily recognized, when present, by its patch-like clusters of short, tawny setae along the elytra. It is similar in form to *Rhyssomatus lineaticollis* (Say, 1824) (see **Diagnosis** of *R. lineaticollis*) and *R. rugulipennis* Champion, 1904, and *R. medialis* (Casey 1895) (see **Diagnosis** of *R. medialis*). *Rhyssomatus palmacollis* can be distinguished from *R. rugulipennis* by possessing irregular patches of yellow pubescence (when present), having a scutellum densely covered with short tawny setae, and stria 2, 4, 6, 8 relatively smooth. Fovea between aforementioned stria with lateral deep, ovate punctures from base to apex, minus between stria 7, 8, 9 where the stria join at the base of the elytra at one point (as opposed to *R. rugulipennis* that possesses small circular punctures, approximately half a punctures width apart).

Redescription.

Habitus. **Male:** Length 4.52-5.79 mm, width 2.29-2.98 mm, length/width ratio 1.83-1.97 (N=4). **Female:** Length 5.23-5.39 mm, width 2.86-2.93mm, length/width ratio 1.78-1.88 (N=2). Body oval from dorsal view. Integument black, glabrous; possesses yellow setae in irregular patches on the elytra (these patches can be worn off with the age of the specimen). Scutellum covered in dense, short tawny setae. Alternate intervals of elytral stria (stria 1, 3, 5, 7, 9) carinate and sharply costate, remaining stria (stria 2, 4, 6, 8) costate but relatively smooth. Stria 7, 8, 9 join at the base of the elytra at one point. Fovea between stria with lateral deep, ovate punctures that are approximately a punctures width apart. Ventral sclerites with densely packed minute punctures. Mesosternum may possess short yellow setae.

Head. Eyes large, narrowly separated (approximately the width of approximately 3-4 facets). Ventral portion of the eyes under the rostrum nearly continuous. Recessed, slightly laterally compressed, medially tapering to a blunt angle anteriorly, posterior portion wide and continuous to pronotum; post ocular vibrissae present, very short. Head shallowly punctate. Setae on head variable, if present they originate from each puncture and are oriented ventrally towards the rostrum.

Antennae. Scrobe laterally descending, antennal scape inserted 1/3 from distal apex of rostrum; recessed in rostrum. Funicle with 8 flagellomeres, club oval in shape, compressed. Flagellomeres and club densely setaceous, said setae not repressed along flagellomeres. Scape without setae.

Mandibles. Decussate and bifurcated.

Rostrum. **Males:** Length 1.12-1.33 mm, rostrum/pronotum length ratio 1.24-1.73, rostrum length/width ratio 5.33-7.92. **Female:** Length 1.88-1.99 mm, rostrum/pronotum length ratio 1.37-1.47, rostrum length/width ratio 5.7-6.22. Rostrum approximately a fourth as long as body, robust, arcuate. Apex of rostrum (approximately 1/4 from apex) with shallow punctures; if present, setae from the punctures minute, almost not leaving the depth of the puncture. The remaining 3/4 of the rostrum is carinate on all sides, again, if setae are present, they are minute and reassessed along the integument except at base where the setae abruptly become longer and are oriented towards the medial carina. Medial carina and setae continue between the eyes. Medial carina bifurcates into a sharp 'V' with the space of 2-3 eye facets between the dorsal portion of the eye and itself.

Pronotum. **Male:** Pronotum length/width ratio 0.59-0.63, pronotum/elytra length (not including elytral curvature) ratio 0.31-0.39. **Female:** Pronotum length/width ratio 0.63-0.67, pronotum/elytra length (not including elytral curvature) ratio 0.36-0.40. Pronotum trapezoidal, possesses a medial carina. Integument distinctly corrugated with ridges bluntly carinate. Presence of setae variable; if present, small and tawny. Distinct anterior pronotal collar present.

Scutellum. Scutellum laterally oval. Densely covered in short yellow setae, recessed into elytra.

Legs. **Male:** Profemur/pronotum length ratio 1.01-1.3; protibia/profemur length ratio 0.76-0.80. **Female:** Profemur/pronotum length ratio 1.02-1.08; protibia/profemur length ratio 0.74-0.8. All femurs with distinct, small anteromesal tooth present. Femur and tibia

sparsely punctate with short to medium yellow setae originating from each puncture.

Protibia with two anterior dorsal teeth in pincer-like form.

Elytra. **Male:** Elytra length/width ratio 2.42-2.84. **Female:** Elytra length/width ratio 2.67-2.73. Elytra very similar to *R. arizonicus* and *R. lineaticollis*. Main difference being the presence, when present, by its patch-like clusters of short, tawny setae along the elytra. Shape oval in dorsal view, lateral margins gradually narrowed towards blunt posterior apex. Alternate intervals of elytra carinate, shallow depressions (fovaea) are found at interstices 3, 5, 7, 9 from the base to the apex, 8 and 10 at the base; fovea with lateral, evenly spaced punctures. Aforementioned interstices 3, 5, 7, 9 sharply costate, remaining interstices relatively smooth.

Terminalia. **Male:** Terminalia with tegmen similar to slightly longer in length to median lobe. Aedeagus lateral margins before converging at the basiventral margin, basiventral margin widely emarginate, lobe-like projections subrounded. Lateral margins nearly straight and roundly/bluntly converging towards apex. **Female:** Apex of sternite 8 with distinct paddle-like flange on apical branches. Lateral margins of stem suddenly curve outwards posteriorly, giving base a fan-like appearance with no flange

Sexual Dimorphism. Protibia anterodorsal tooth present in both sexes. Males bluntly subtriangular, arcuate in comparison to females

Etymology. The name *palmacollis* is a derivative of two Latin roots; “*palma*” meaning ‘palm’ or ‘concave’ and “*collis*” meaning ‘hill’. This may refer to the elytral grooves present in the species. In his original description, Say states “(t)horax with numerous small grooves.

Material Examined.

ARTSYS0008060 - ARTSYS0008069; ARTSYS0008071 - ARTSYS0008085;
ARTSYS0008133; ARTSYS0008139; ARTSYS0008188 - ARTSYS0008206;
ARTSYS0008603 - ARTSYS0008610; ARTSYS0008612; ARTSYS0008637 -
ARTSYS0008638.

ASUCOB0008606 - ASUCOB0008612; ASUCOB0008614 - ASUCOB0008619;
ASUCOB0008621 - ASUCOB0008628; ASUCOB0008630 - ASUCOB0008657;
ASUCOB0023069.

ASUHIC0127577; ASUHIC0127720.

FMNHINS4188238 - FMNHINS4188260; FMNHINS4188263 - FMNHINS4188267.

MCZENT00682002 - MCZENT00682013.

Habitat Range.

United States: Washington DC, Indiana, New Jersey, Ohio, Pennsylvania, Arkansas, Florida, Mississippi, North Carolina, South Carolina, Tennessee, Texas, Kansas, Alabama, Kentucky, Colorado, Delaware, Nebraska, Georgia, Missouri, Louisiana, Arizona, Oklahoma, Illinois, Maryland, New York, Michigan; Mexico.

Rhyssomatus palmacollis (Say, 1831)

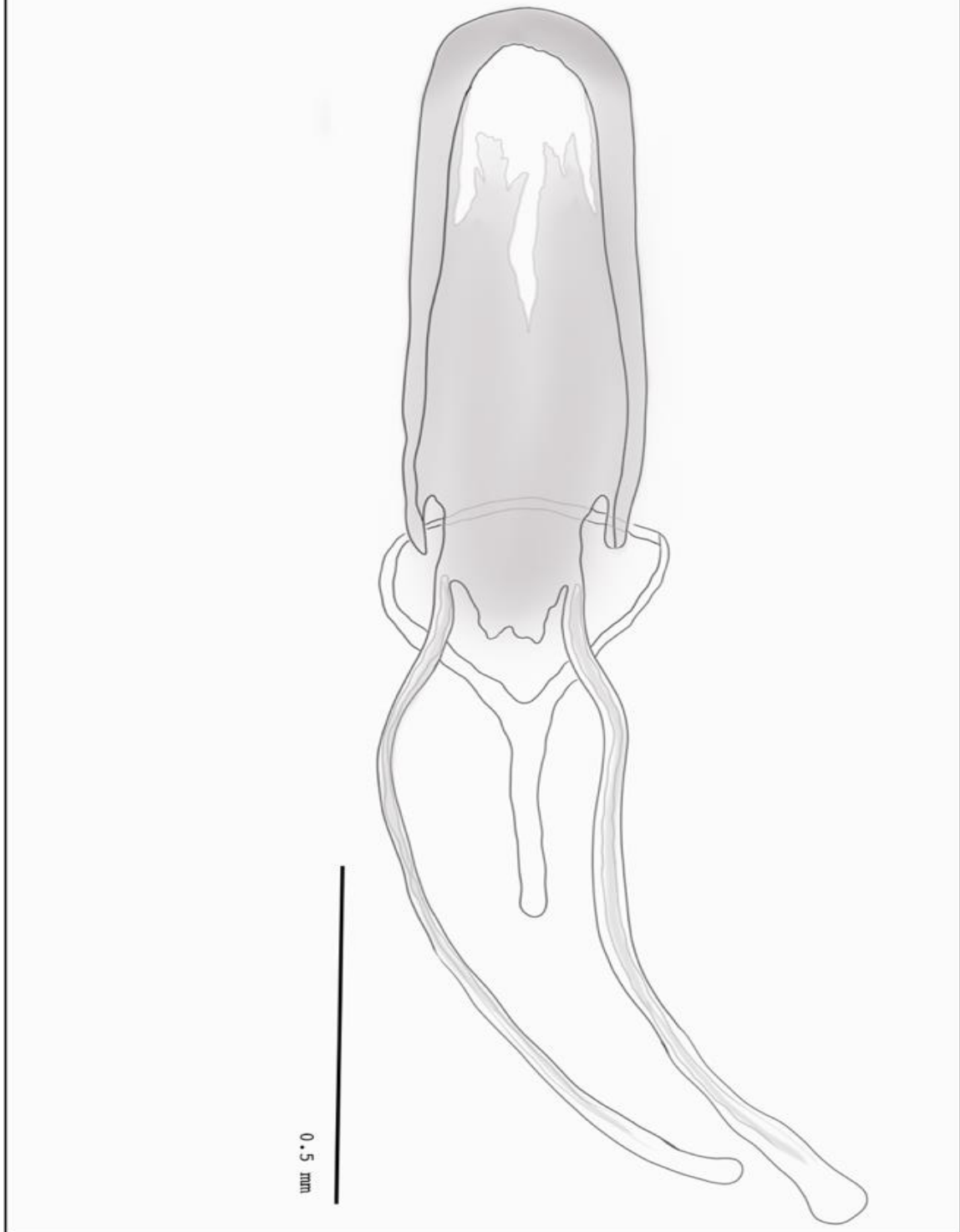


FIGURE 60: *Rhyssomatus palmacollis* male genitalia.

Rhyssomatus palmacollis (Say, 1831)

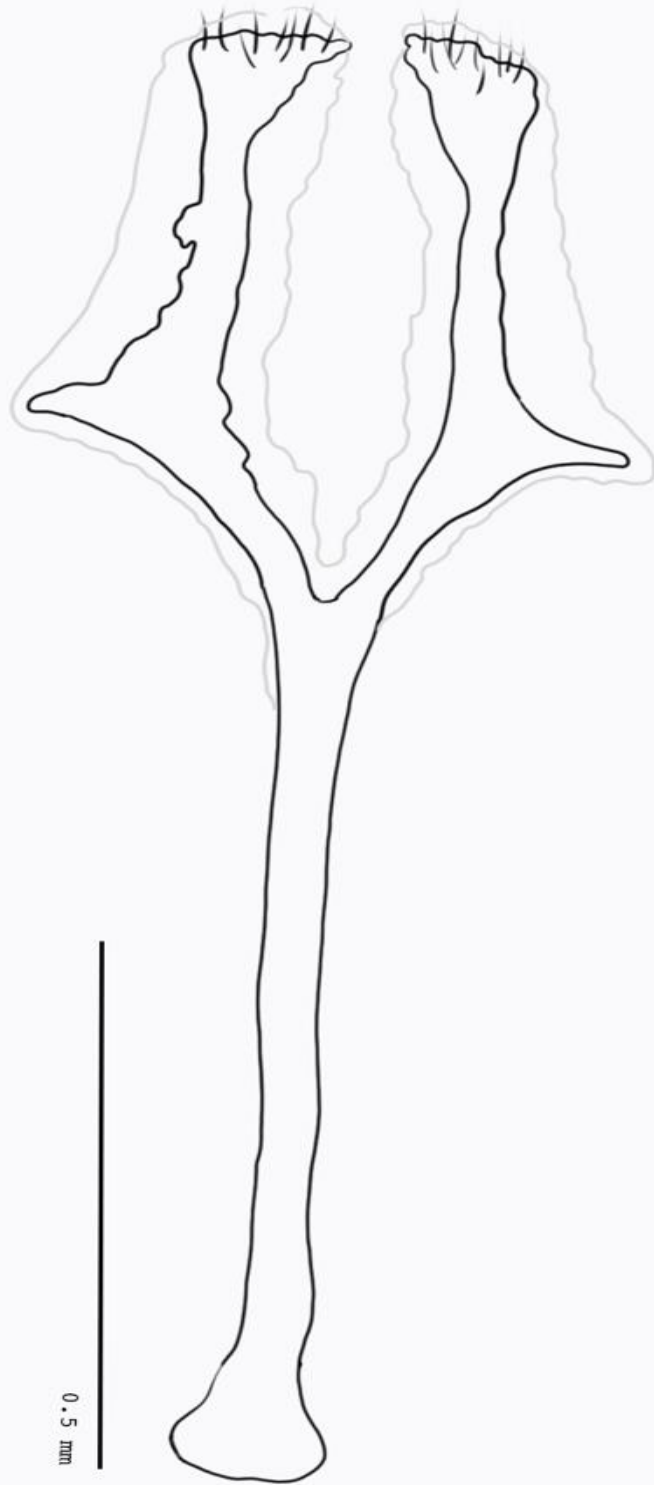


FIGURE 61: *Rhyssomatus palmacollis* female genitalia.



FIGURE 62: *Rhyssomatus palmacollis* dorsal image.



FIGURE 63: *Rhyssomatus palmacollis* lateral image.



FIGURE 64: *Rhyssomatus palmacollis* frontal image.

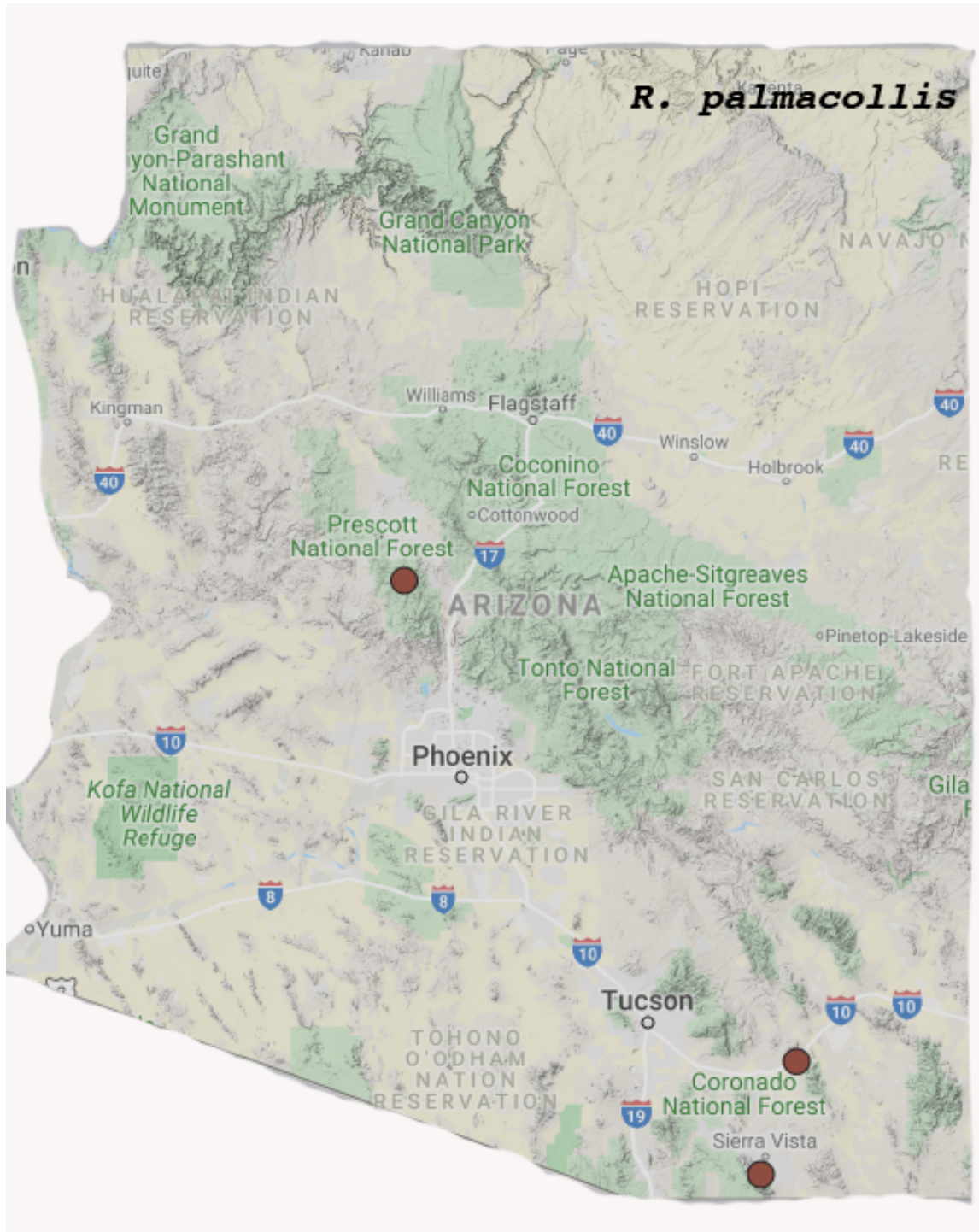


FIGURE 65: *Rhyssomatus palmacollis* distributional map of Arizona; sourced from Ecdysis Portal. 2023.

Rhyssomatus parvulus (Casey, 1895)

= *Rhyssomatus parvulus* [Casey 1895:835]

Holotype. Smithsonian - The National Museum of Natural History (NMNH); USA, Washington, D.C.

New Mexico (San Augustine). Mr. Cockerell (Casey 1895: 836).

Habitat Range. United States: Arizona, New Mexico, Texas; Mexico.

Diagnosis. *Rhyssomatus parvulus* is the smallest of the Arizona *Rhyssomatus* and possesses a distinctly punctate abdomen and slight divet located medially in apical pronotal collar. When considering only Arizona occurring species, *Rhyssomatus parvulus* is most similar in form to *R. oculatus* Schaffer, 1909 (see **Diagnosis** of *R. oculatus*), *R. ovalis* Casey 1892 (see **Diagnosis** of *R. ovalis*), and *R. pruinosis* (Boheman, 1895). Easily distinguished from *R. pruinosis* by widely separated eyes.

Redescription.

Habitus. **Male:** Length 3.39 mm, width 1.80 mm, length/width ratio 1.87, elytra length/width ratio 2.82 (N=1). **Female:** Length 3.82-3.84mm mm, width 1.89-1.98mm, length/width ratio 1.93-2.03 (N=2). Body narrowly oval from dorsal view with lateral margins nearly straight and converging rapidly at apex arcuately. Integument rubescent overall. Short, whitish setae present only on legs and abdomen. Ventral portion of body

sparsely punctate. Humeri distinct. Alternate intervals of elytra distinctly carinate with shallow depressions (fovea); punctures separated by the puncture's diameter or more.

Aforementioned interstices bluntly costate. Smallest of the Arizona *Rhysomatus* species.

Head. Eyes large, widely separated (approximately the width of 7-8 facets). Ventral portion of the eyes under the rostrum nearly continuous. Recessed, slightly laterally compressed, medially tapering to a blunt angle anteriorly, posterior portion wide and continuous to pronotum; post ocular vibrissae present, very short. Head shallowly punctate. No setae on head.

Antennae. Scrobe laterally descending, antennal scape inserted 1/3 from distal apex of rostrum; recessed in rostrum. Funicle with 8 flagellomeres, club oval in shape, compressed. Flagellomeres and club densely setaceous, said setae not repressed along flagellomeres.

Mandibles. Decussate and bifurcated.

Rostrum. **Males:** Length 1.20mm, rostrum/pronotum length ratio 0.78, rostrum length/width ratio 5.22. **Female:** Length 1.3-1.32 mm, rostrum/pronotum length ratio 1.21-1.31, rostrum length/width ratio 6.5-7.76. Rostrum thin; approximately a third as long as body, arcuate. Apex of rostrum may possess shallow punctures. The remaining $\frac{3}{4}$ of the rostrum with shallow punctures, no setae present. Medial carina present.

Pronotum. **Male:** Pronotum length/width ratio 0.58, pronotum/elytra length (not including elytral curvature) ratio 0.42. **Female:** Pronotum length/width ratio 0.68-0.71, pronotum/elytra length (not including elytral curvature) ratio 0.40-0.43. Pronotum trapezoidal. Distinct pronotal collar present. Possess shallow punctures in a corrugated

pattern all throughout. If present, setae are within punctures, length as long as depth of punctures.

Scutellum. Scutellum either laterally oval or circular in appearance, recessed into elytra.

No setae present.

Legs. **Male**: Profemur/pronotum length ratio 1.09; protibia/profemur length ratio 0.90.

Female: Profemur/pronotum length ratio 1.03-1.05; protibia/profemur length ratio 2.37-2.61. All femurs with distinct, small anteromesal tooth present. Femur and tibia sparsely punctate with short to medium yellow setae originating from each puncture.

Elytra. **Male**: Elytra length/width ratio 0.27. **Female**: Elytra length/width ratio 1.37-2.61.

Shape laterally oval in dorsal view. Lateral margins gradually narrowed towards blunt posterior apex. Alternate intervals of elytra non-carinate, instead possessing lateral rows of evenly spaced shallow depressions (character placing this species in the subgenus *Sermysatus*).

Terminalia. **Male**: Aedeagus lateral margins nearly straight, converging on a squarish blunt apex (distinct from all other male genitalia in the Arizona occurring species of *Rhyssomatus*). Lateral margins at distal ending in blunt circular lobes. **Female**. Sternite 8 with apical branches twice as long as stem. Flanges or fan-like structures, if present, small and positioned centerly on apical branches. Long and thin overall. Apical branches forming a distinct narrow “V” shape; converging at the apex, nearly touching. Apex of branches with short, sparse setae.

Etymology. The Latin root of the name *parvulus* translates directly to ‘small’. This is the smaller species of *Rhyssomatus* in North America. In his originally description Casey states “(t)his is the smallest of the genus known to me(.)”

Material Examined.

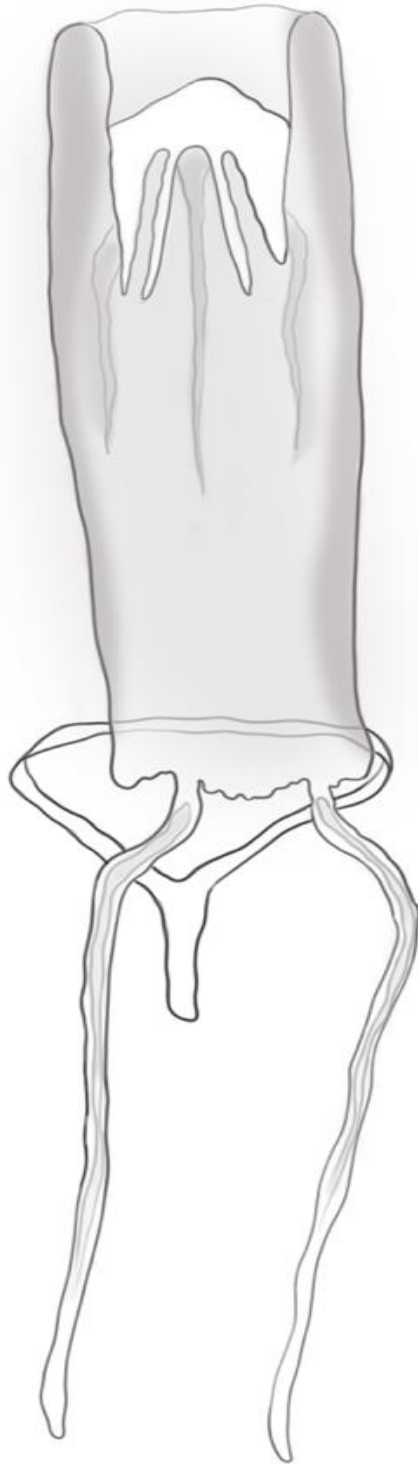
ARTSYS0008207 - ARTSYS0008602.

ASUCOB0008412; ASUCOB0008658 - ASUCOB0008714; ASUCOB0022725 -
ASUCOB0022747; ASUCOB0023070; ASUHIC0127713 - ASUHIC0127718.

FMNHINS4188278 - FMNHINS4188282.

MCZENT00682046 - MCZENT00682047.

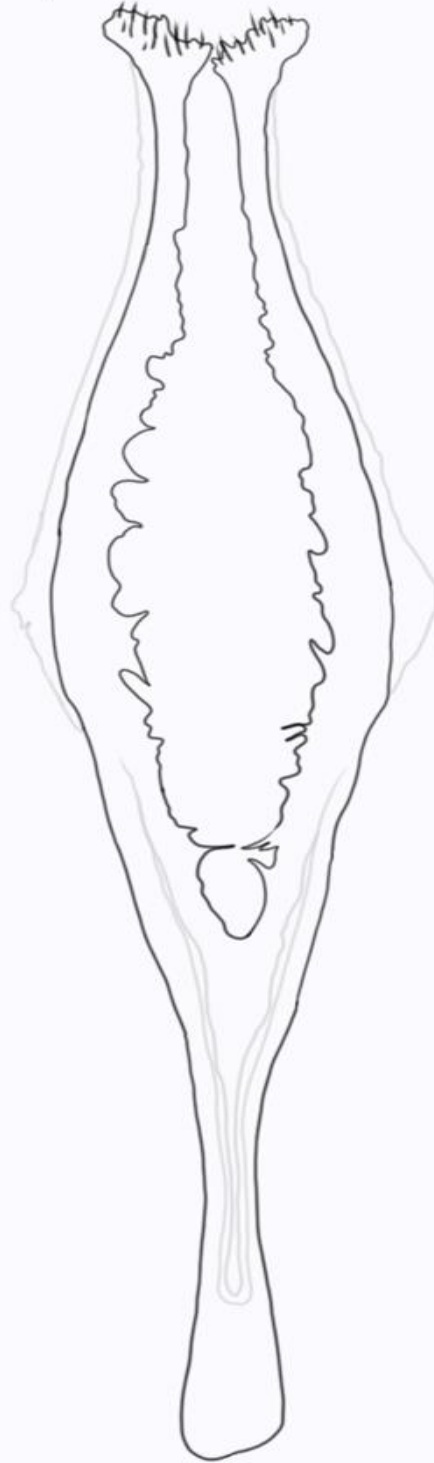
Rhyssomatus parvulus (Casey, 1895)



0.5 mm

FIGURE 66: *Rhyssomatus parvulus* male genitalia.

Rhyssomatus parvulus (Casey, 1895)



0.5 mm

FIGURE 67: *Rhyssomatus parvulus* female genitalia.



FIGURE 68: *Rhyssomatus parvulus* dorsal image.



FIGURE 69: *Rhyssomatus parvulus* lateral image.



FIGURE 70: *Rhyssomatus parvulus* frontal image.

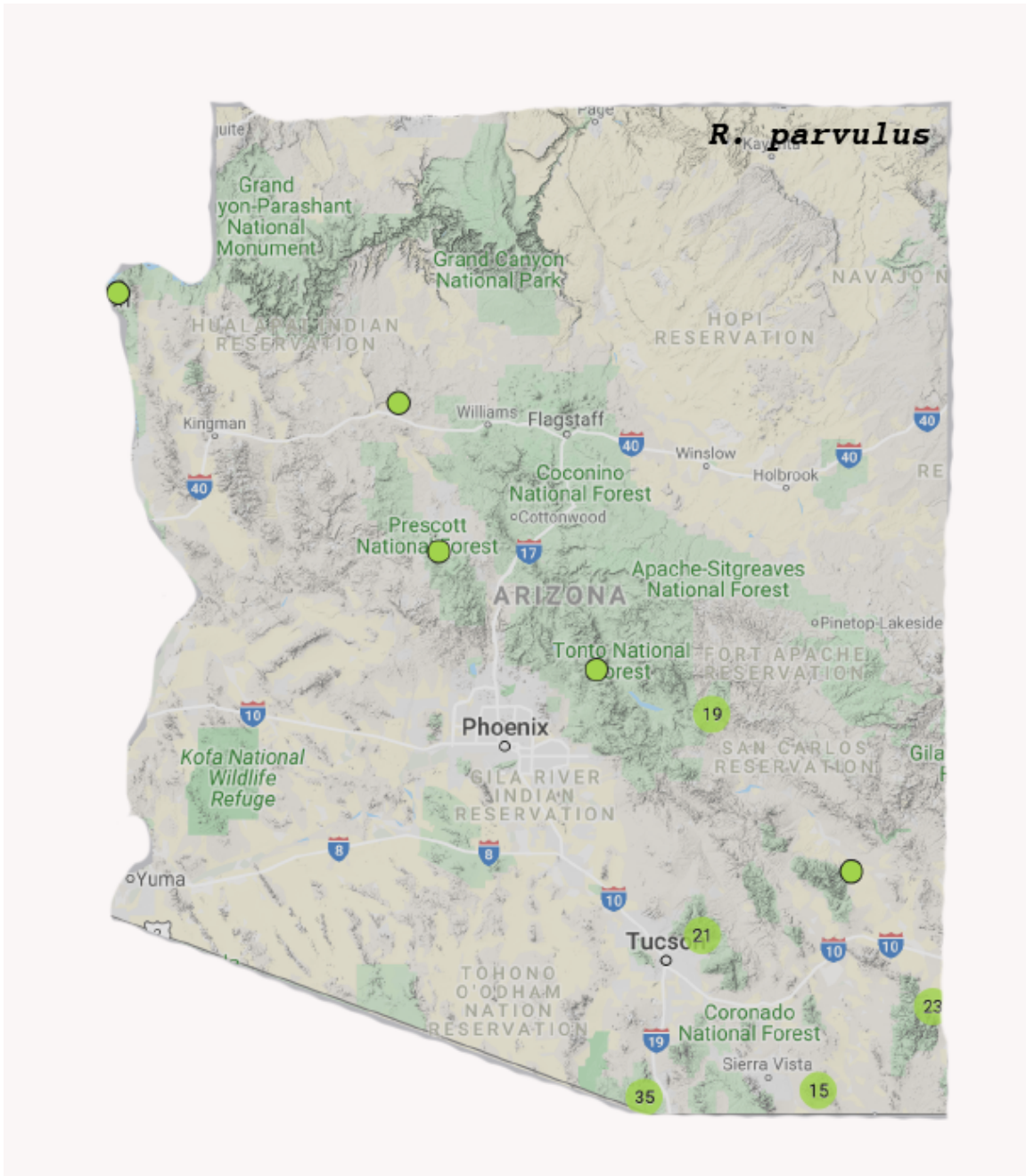


FIGURE 71: *Rhyssomatus parvulus* distributional map of Arizona; sourced from Ecdysis Portal. 2023.

Rhyssomatus pruinosus (Boheman, 1845)

= *Chalcodermus pruinosus* [Boheman 1845:13]

Holotype. Swedish Museum of Natural History, Naturhistoriska Riksmuseet (NHRS); Sweden Goteborg.

Habitat Range. United States: Arizona, California, Texas, New Mexico; Mexico.

Diagnosis. *Rhyssomatus pruinosus* is easily distinguishable from *Rhyssomatus oculatus* Schaeffer, 1909 by having alternate intervals of the elytra not carinate, a character distinguishing *R. pruinosus* within the subgenus *Sermysatus*. Recognizable by having eyes nearly touching as opposed to the widely separated eyes of *R. ovalis* Casey, 1892 and *R. parvulus* Casey, 1895.

Redescription.

Habitus. **Male:** Length 4.61-5.10 mm, width 2.38-2.62 mm, length/width ratio 1.94-1.95 (N=2). **Female:** Length 5.18-5.65mm, width 2.80-2.88 mm, length/width ratio 1.85-1.96 (N=2). As the name suggests, the integument is covered in a light ‘frosty’ covering of minute yellow-white setae. Integument rufus. Ventral portion of body sparsely punctate with long setae immiting from each puncture. Humeri feeble but distinct, nearly continuous with pronotum. Alternate intervals of elytra non-carinate, instead possessing

lateral rows of evenly spaced shallow depressions (character placing this species in the subgenus *Sermysatus*).

Head. Eyes narrowly separated (approximately the width of 5-7 facets), eyes recessed, slightly laterally compressed, medially tapering to a blunt angle, distal portion wide and continuous to pronotum with short yellowish setae surrounding perimeter of entire eye.

Head densely punctate (punctures separated by approximately half the width of a puncture). Head densely setaceous, setae arise from punctures, laterally descending towards rostrum.

Antennae. Scrobe laterally descending, antennal scape inserted 1/3 from distal apex of rostrum. Funicle with 7 flagellomeres, club oval in shape, compressed. Flagellomeres and club densely setaceous. Scape with sparse setae, if present.

Mandibles. Decussate and bifurcated.

Rostrum. **Males:** Length 1.48-1.68 mm, rostrum/pronotum length ratio 1.41-1.54, rostrum length/width ratio 8-8.22. **Female:** Length 1.90-2.04 mm, rostrum/pronotum length ratio 1.52-1.56, rostrum length/width ratio 8.26-11.33. Rostrum thin; approximately a fourth as long as body, arcuate. Apex of rostrum may possess shallow punctures along the fovea of the rostral carini. Medial carina present.

Pronotum. **Male:** Pronotum length/width ratio 0.59-0.64, pronotum/elytra length (not including elytral curvature) ratio 0.28-0.33. **Female:** Pronotum length/width ratio 0.63-0.64, pronotum/elytra length (not including elytral curvature) ratio 0.28-0.33. Pronotum trapezoidal. Distinct pronotal collar present. Possess shallow punctures in a corrugated

pattern all throughout. Setae are within punctures, length as long as depth of punctures, yellowish in color.

Scutellum. Scutellum small, glabrous, rubescent; recessed into elytra.

Legs. Male: Profemur/pronotum length ratio 1.19-1.4; protibia/profemur length ratio 0.72-0.73. **Female:** Profemur/pronotum length ratio 1.12-1.16; protibia/profemur length ratio 0.67-0.75. All femurs with distinct anteromesal tooth present. Femur and tibia densely punctate covered in short yellow-white setae orienting from punctures.

Elytra. male: Elytra length/width ratio 2.80-2.83. **female:** Elytra length/width ratio 2.41-2.84. Shape laterally oval in dorsal view. Lateral margins gradually narrowed towards blunt posterior apex. Alternate intervals of elytra non-carinate, instead possessing lateral rows of evenly spaced shallow depressions, separated by approximately half the diameter of a puncture (character placing this species in the subgenus *Sermysatus*). Possess minute yellow-white setae within each puncture.

Terminalia. Male: Terminalia with tegmen similar to slightly longer in length to median lobe. Lateral margins nearly straight and gently diverge at apex, roundly blunted.

Female: Sternite 8 with apical branches twice as long as stem. Flanges or fan-like structures, if present, small and positioned centerly on apical branches. Long and thin overall. Apical branches forming a distinct narrow “V” shape; converging at the apex, nearly touching. Apex of branches with short, sparse setae.

Etymology. The name *pruinus* directly translates to ‘frosty’ in Latin.

Material Examined.

ARTSYS0008273 - ARTSYS0008328; ARTSYS0008482 - ARTSYS0008487;

ARTSYS0008653 - ARTSYS0008719; ARTSYS0008729 - ARTSYS0008743.

ASUCOB0008413; ASUCOB0008715 - ASUCOB0008768; ASUCOB0022806 -

ASUCOB0022814; ASUCOB0023072.

ASUHIC0127719.

FMNHINS4188269 - FMNHINS4188277.

MCZENT00682031 - MCZENT00682045.

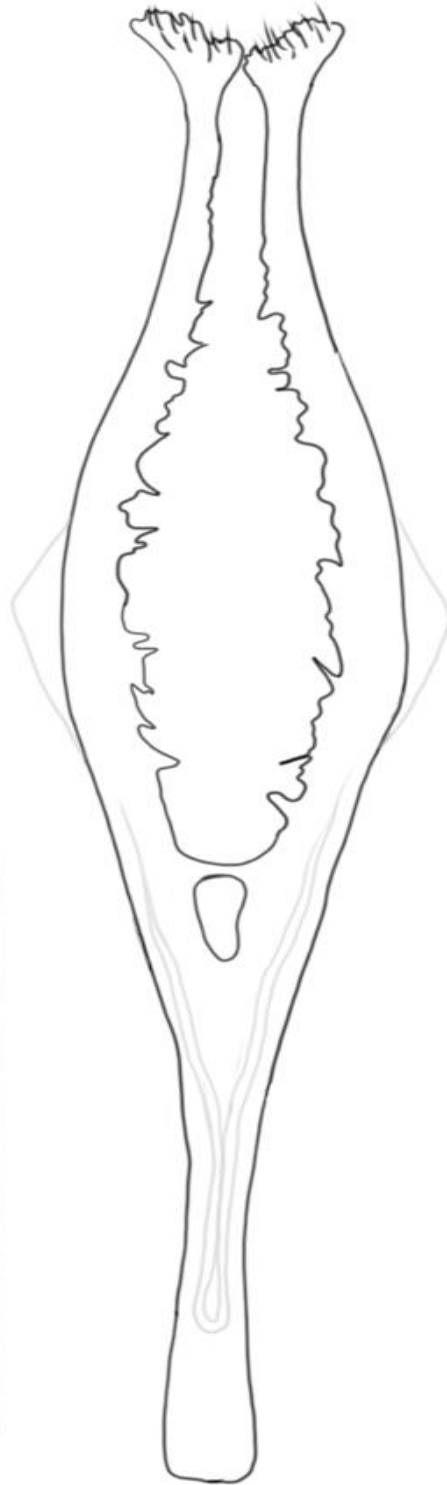
Rhyssomatus pruinus (Boheman, 1845)



0.5 mm

FIGURE 72: *Rhyssomatus pruinus* male genitalia.

Rhyssomatus pruinosus (Boheman, 1845)



0.5 mm

FIGURE 73: *Rhyssomatus pruinosus* female genitalia.



FIGURE 74: *Rhyssomatus pruinus* dorsal image.



FIGURE 75: *Rhyssomatus pruinus* lateral image.



FIGURE 76: *Rhyssomatus pruinus* frontal image.



FIGURE 77: *Rhyssomatus pruinosis* distributional map of Arizona; sourced from Ecdysis Portal. 2023.

Rhyssomatus pubescens Horn, 1873

= *Rhyssomatus pubescens* [Austin 1880:50]

= *Ryssematus pubescens* [Casey 1892:833]

Holotype. Type in California Academy of Sciences (CAS); USA, California, San Francisco. Owen's Valley, California (Horn 1873:465).

Diagnosis. *Rhyssomatus pubescens* is most similar in form to *Rhyssomatus medialis* (Casey, 1895) (see **Diagnosis** of *R. medialis*).

Redescription.

Habitus. **Male:** Length 5.07-7.15 mm, width 2.80-3.88 mm, length/width ratio 1.79-1.88 (N=1). **Female:** Length 4.43-5.3 mm, width 2.48-2.98 mm, length/width ratio 1.78-1.87 (N=3). One of the most distinguishable of the Arizona *Rhyssomatus* species due to its thick covering of yellowish long setae evenly distributed across pronotum and elytra. Body widely ovate from dorsal view. Alternate elytral intervals are flat; pronotum obliquely corrugated. Medial carina, if present, feeble. Scutellum sparsely covered in short, twany setae. Alternate intervals of elytra carinate, shallow depressions (fovae) are found at interstria 3, 5, 7, 9 from the base to the apex, 8 and 10 at the base; foveae with lateral, evenly spaced, ovate punctures. Aforementioned interstices 3, 5, 7, 9 sharply costate, remaining interstices relatively smooth.

Head. Head with eyes narrowly separated (approximately the width of 5-7 facets), eyes recessed, slightly laterally compressed, medially tapering to a blunt angle, distal portion wide and continuous to pronotum. Head densely punctate with a corrugated appearance, sparsely covered in short yellow setae.

Antennae. Scrobe laterally descending, antenna inserted 1/3 from distal apex of rostrum. Funicle with 7 flagellomeres, club oval in shape, compressed, pubescent.

Mandibles. Decussate and bifurcated.

Rostrum. **Males:** Length 1.46 mm, rostrum/pronotum length ratio 1.57, rostrum length/width ratio 6.64. **Female:** Length 1.57-1.94 mm, rostrum/pronotum length ratio 1.34-1.54, rostrum length/width ratio 5.82-8.19. Rostrum thin; approximately a third as long as body, arcuate. Medial carina present. Two to three lateral carini present around the rostrum. Fovea of carini with shallow punctures; if present, minute yellow-white setae arise from said punctures, length the height of said punctures.

Pronotum. **Male:** Pronotum length/width ratio 0.62, pronotum/elytra length (not including elytral curvature) ratio 0.90. **Female:** Pronotum length/width ratio 0.61-0.67, pronotum/elytra length (not including elytral curvature) ratio 0.34-0.44. Pronotum trapezoidal. Distinct pronotal collar present. Possess shallow punctures in a obliquely corrugated pattern all throughout. Setae are within punctures, length is long, yellowish in color. Medial carina not carinate.

Scutellum. Scutellum laterally oval. Densely covered in short yellow setae, recessed into elytra.

Legs. Male: Profemur/pronotum length ratio 1.11; protibia/profemur length ratio 0.72.

Female: Profemur/pronotum length ratio 0.91-1.1; protibia/profemur length ratio 0.85-0.93. All femurs with distinct anteromesal tooth present. Femur and tibia densely punctate covered in long yellow-white setae orienting from punctures.

Elytra. male: Elytra length/width ratio 2.49. **female:** Elytra length/width ratio 2.16-2.5.

Shape oval in dorsal view, lateral margins gradually narrowed towards blunt posterior apex. Long yellow-white setae arise from punctures along fovea. Alternate intervals of elytra carinate, shallow depressions (fovaea) are found at interstices 3, 5, 7, 9 from the base to the apex, 8 and 10 at the base; fovea with lateral, evenly spaced punctures.

Aforementioned interstices 3, 5, 7, 9 sharply costate, remaining interstices relatively smooth.

Terminalia.

Etymology. The name *pubescens* directly translates to ‘hairy’ in Latin.

Material Examined.

ARTSYS0008086 - ARTSYS0008092; ARTSYS0008639 - ARTSYS0008652;

ARTSYS0008775 - ARTSYS0008787.

ASUCOB0008414; ASUCOB0008767; ASUCOB0008769 - ASUCOB0008772.

FMNHINS4188268.

Habitat Range. United States: California, Arizona, Texas; Mexico.

Rhyssomatus pubescens Horn, 1873

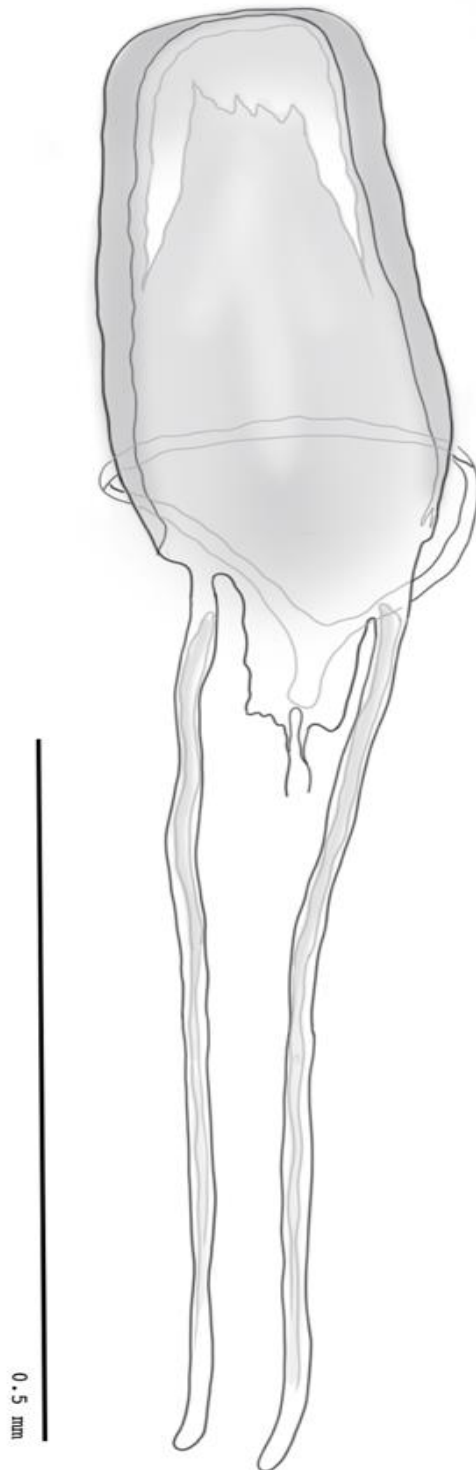


FIGURE 78: *Rhyssomatus pubescens* male genitalia.

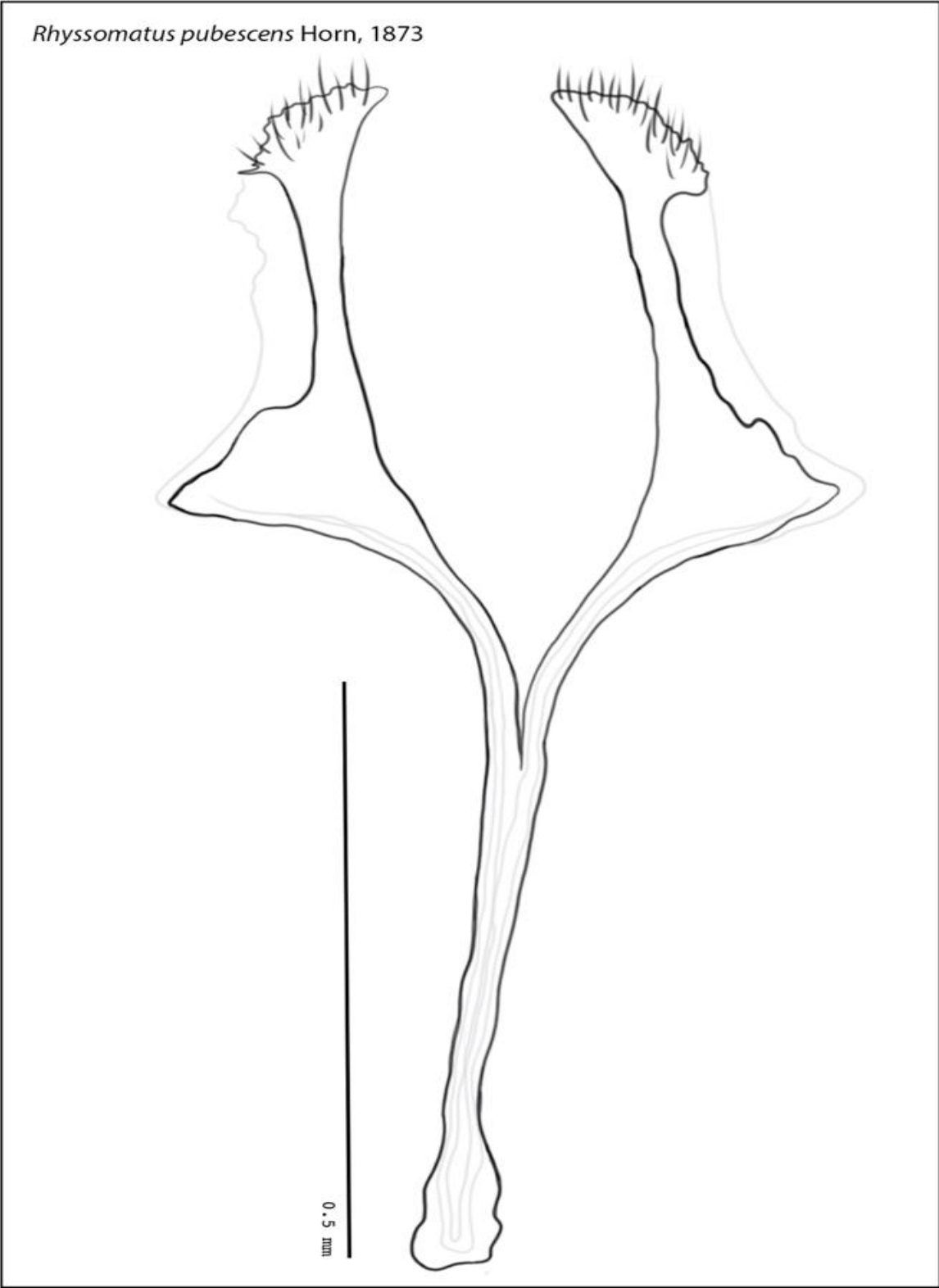


FIGURE 79: *Rhyssomatus pubescens* female genitalia.



FIGURE 80: *Rhysomatus pubescens* dorsal image.



FIGURE 81: *Rhysomatus pubescens* lateral image.



FIGURE 82: *Rhyssomatus pubescens* frontal image.

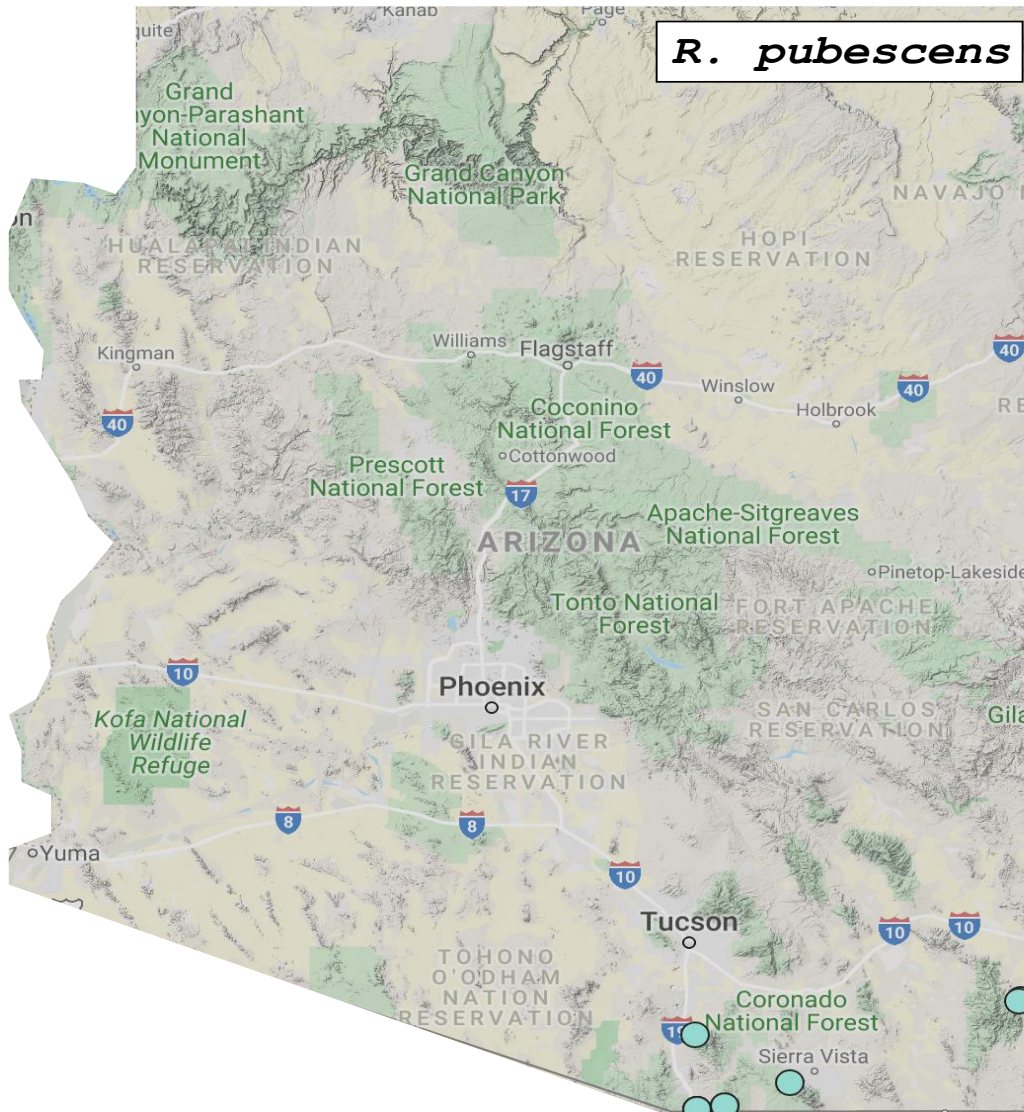


FIGURE 83: *Rhyssomatus pubescens* distributional map of Arizona; sourced from Ecdysis Portal. 2023.

Rhyssomatus rugulipennis Champion, 1904

Holotype. Type in The Natural History Museum of London (HNMUK); UK, England, London; Mexico, Durango city (Hoge), Sierra de Durango (ex Flohr.) (Champion 1904:328).

Diagnosis. *Rhyssomatus rugulipennis* is most similar in form to *R. arizonicus* Van Dyke 1930 (see **Diagnosis** of *R. arizonicus*), *R. lineaticollis* (Say, 1824) (see **Diagnosis** of *R. lineaticollis*), and *R. palmacollis* (Say, 1831) (see **Diagnosis** of *R. palmacollis*).

Redescription.

Habitus. **Male:** Length 6.28-9.02 mm, width 3.34-4.73 mm, length/width ratio 1.83-2.06 (N=7). **Female:** Length 6.08-7.84 mm, width 3.16-4.28 mm, length/width ratio 1.79-1.95 (N=8). Body oval from dorsal view. Integument black overall with antennae rubescent. Ventral portion of body closely punctate with 5th abdominal ventral sclerite densely punctate. Distinct humeri curves and tapers quickly anteriorly before pronotum giving a cinched appearance. Alternate intervals of elytra carinate, shallow depressions (fovaea) are found at interstria's 3, 5, 7, 9 from the base to the apex, 8 and 10 at the base; fovea with lateral, evenly spaced punctures. Aforementioned interstices 3, 5, 7, 9 sharply costate, remaining interstices relatively smooth. Can be distinguished from *Rhyssomatus lineaticollis* by clusters of minute yellow-white setae within punctures.

Head. Eyes narrowly separated (approximately the width of 4-5 facets), eyes recessed, slightly laterally compressed, medially tapering to a blunt angle, distal portion wide and continuous to pronotum with short yellowish setae surrounding perimeter of entire eye. Head densely punctate, short to long setae projecting from each puncture oriented downward toward the apex of rostrum.

Antennae. Scrobe laterally descending, antennal scape inserted 1/3 from distal apex of rostrum. Funicle with 7 flagellomeres, club oval in shape, compressed. Flagellomeres and club densely setaceous, scape with sparse setae.

Mandibles. Decussate and bifurcated.

Rostrum. **Males:** Length 1.97-2.22 mm, rostrum/pronotum length ratio 1.09-1.49, rostrum length/width ratio 3.6-5.29. **Female:** Length 1.72-2.24 mm, rostrum/pronotum length ratio 1.04-1.36, rostrum length/width ratio 2.98-5.54. Rostrum slightly curved ventrally, basal half continuous with frons, not depressed. Rostrum with sharply defined medial carina that extends between the eyes before bifurcating slightly, flanked laterally by multiple carina at basal half; all carina taper 1/4 from distal apex. Basal portion of rostrum with sparse yellow setae.

Pronotum. **Male:** Pronotum length/width ratio 0.42-0.64, pronotum/elytra length (not including elytral curvature) ratio 0.27-0.41. **Female:** Pronotum length/width ratio 0.58-0.62, pronotum/elytra length (not including elytral curvature) ratio 0.32-0.38. Pronotum trapezoidal, possesses a medial carina. Possess minute yellow setae contained inside each puncture. Integument feebly corrugated. Distinct anterior pronotal collar present.

Scutellum. Scutellum laterally oval. Short yellow setae on outer edges, recessed into elytra.

Legs. **Male:** Profemur/pronotum length ratio 0.95-1.25; protibia/profemur length ratio 0.63-0.88. **Female:** Profemur/pronotum length ratio 1.01-1.17; protibia/profemur length ratio 0.70-0.95. All femurs with distinct anteromesal tooth present. Femur and tibia densely punctate covered in long yellow-white setae orienting from punctures.

Elytra. **Male:** Elytra length/width ratio 2.43-3.01. **Female:** Elytra length/width ratio 2.38-2.78. Shape ovate to subtriangular, prominent humeri forming an almost continuous outline with sides of pronotum. Can be distinguished from *Rhyssomatus lineaticollis* by clusters of minute yellow-white setae within punctures.

Terminalia. **Male:** Terminalia with tegmen similar to slightly longer in length to median lobe. Aedeagus lateral margins before converging at the basiventral margin, basiventral margin widely emarginate, lobe-like projections subrounded. Lateral margins nearly straight and roundly/bluntly converging towards apex. **Female:** Apex of sternite 8 with distinct paddle-like flange on apical branches. Lateral margins of stem suddenly nearly straight to distal end.

Etymology. There may be different interpretations of the source for the name of *rugulipennis*. The latin interpretation is “*rugul*” meaning wrinkled and “*pennis*” meaning feather.

Material Examined.

ARTSYS0008110 - ARTSYS0008124; ARTSYS0008611; ARTSYS0008758.

ASUCOB0008415 - ASUCOB0008416; ASUCOB0008786 - ASUCOB0008800;

ASUCOB0008821 - ASUCOB0008849; ASUCOB0022748 - ASUCOB0022751;

ASUCOB0023076; ASUCOB0023078.

ASUHIC0127583 - ASUHIC0127625; ASUHIC0127636; ASUHIC0127637.

Habitat Range. United States: Arizona, New Mexico, Texas, Utah.

Rhyssomatus rugulipennis Champion, 1904



FIGURE 84: *Rhyssomatus rugulipennis* male genitalia.

Rhyssomatus rugulipennis Champion, 1904

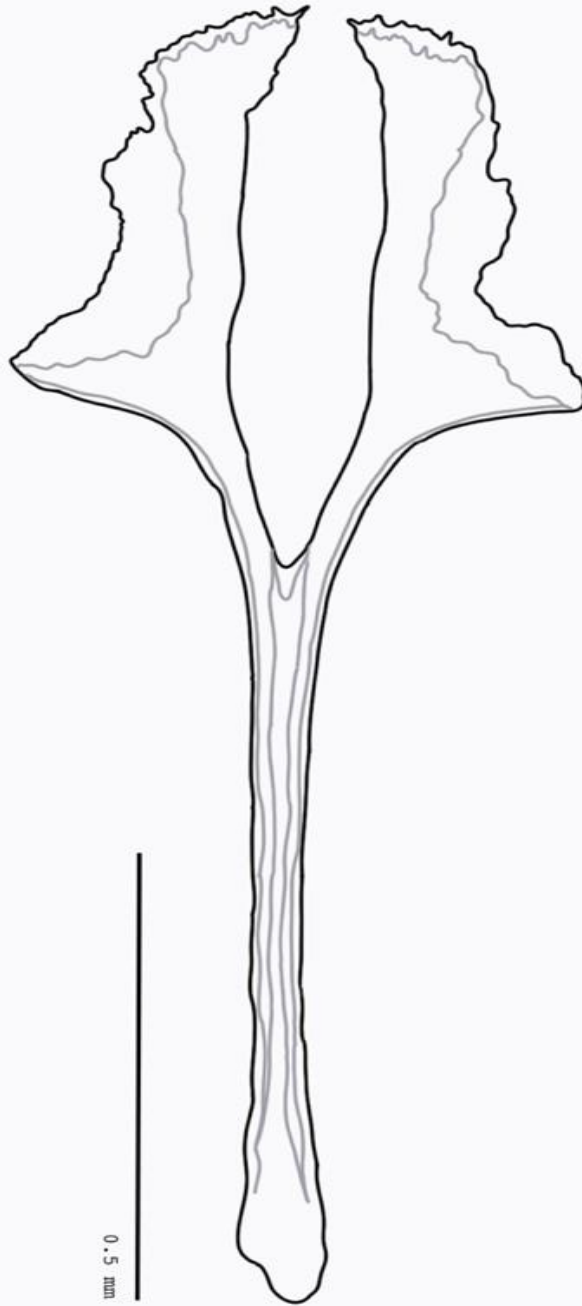


FIGURE 85: *Rhyssomatus rugulipennis* female genitalia.



FIGURE 86: *Rhyssomatus rugulipennis* dorsal image.



FIGURE 87: *Rhyssomatus rugulipennis* lateral image.



FIGURE 88: *Rhyssomatus rugulipennis* frontal image.

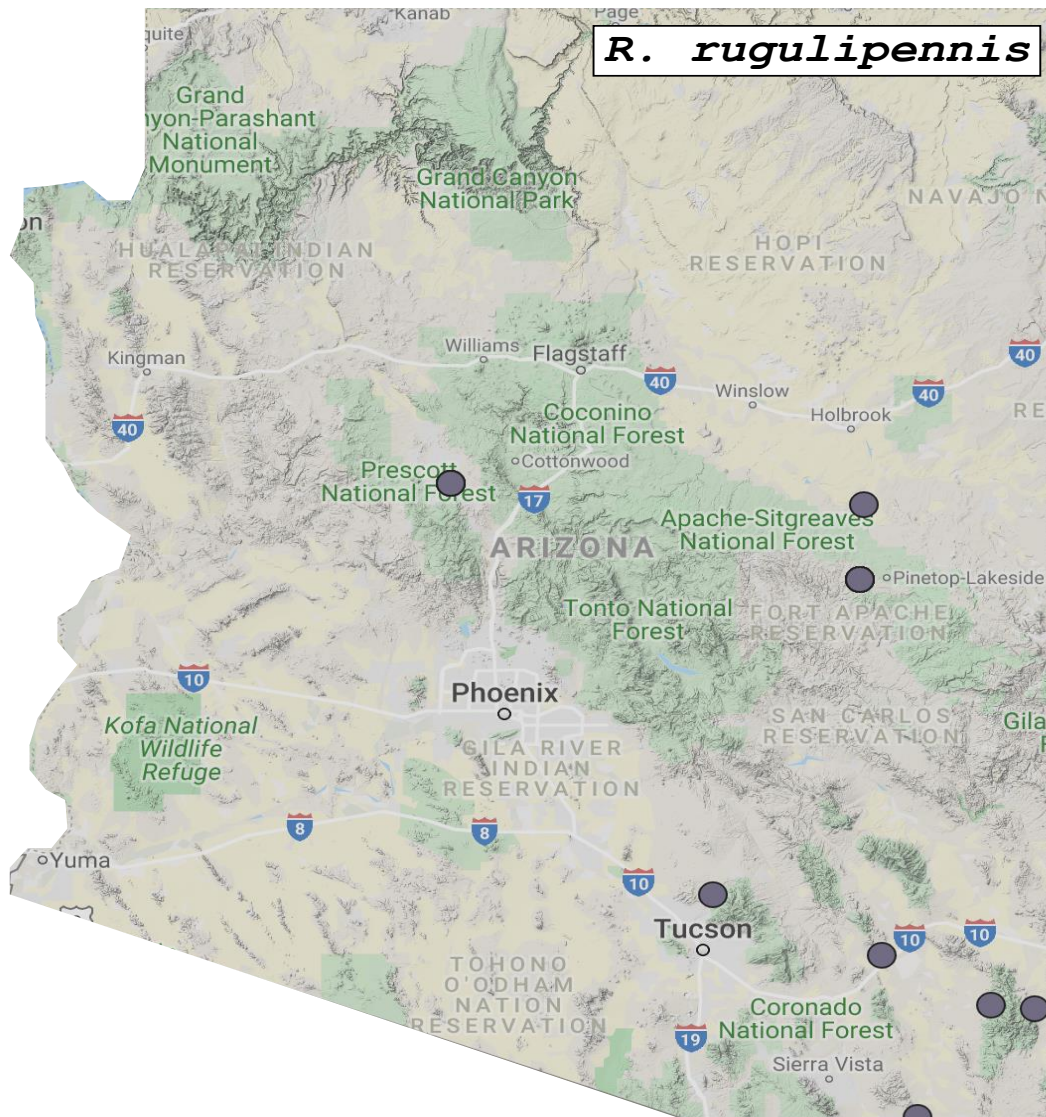


FIGURE 89: *Rhyssomatus rugulipennis* distributional map of Arizona; sourced from Ecdysis Portal. 2023.

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